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**ENVIRONMENTAL
RESTORATION
PROGRAM**

**Preliminary Screening of Contaminants
in the Off-Site Surface Water
Environment Downstream of
the U.S. Department of Energy
Oak Ridge Reservation**

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FOR THE UNITED STATES
DEPARTMENT OF ENERGY
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Environmental Restoration Division
Off-Site Investigations Environmental Restoration Program

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Note to Recipients of ORNL/ER-9

The draft version of this report was distributed in March 1990. Only minor changes were made for this final version; substantial revisions to the draft were unnecessary.

*Environmental Restoration Program
Martin Marietta Energy Systems, Inc.*

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ABSTRACT

Previously reported concentrations of radionuclides and of inorganic and organic compounds in the surface water environment off-site of the U.S. Department of Energy/Oak Ridge Reservation (DOE/ORR) suggest the presence of a large number of substances of possible concern to the protection of human health and the ecosystem. Screening of these data, as part of the initial scoping phase of the Clinch River Resource Conservation and Recovery Act Facility Investigation, is necessary to develop a field sampling plan for the acquisition of additional data through the identification of potential contaminants of concern for further evaluation and investigation. The results of this report are based on human health risk end points. For the purposes of screening, conservative and nonconservative estimates of potential maximum exposures were used to identify, respectively, definitely low- and definitely high-priority pollutants. Because of relatively high concentrations of contaminants in sediment, the presence of industrial and agricultural wastes not related to DOE/ORR operations, and the use of a lifetime risk for carcinogens of 10^{-6} as a lower screening criterion, no surface water reach considered in this study was identified as low priority. In contrast to this result, three contaminants, arsenic in water and thallium in fish of McCoy Branch and ^{137}Cs in the sediment of the White Oak Creek embayment downstream from White Oak Lake, were tentatively identified as definitely high-priority substances. These locations are within the boundaries of ORR. Nonconservative estimates of exposure identified arsenic, antimony, thallium, uranium, polychlorinated biphenyls 1254 and 1260, chlordane, ^{60}Co , and ^{24}Pa as potentially high-priority contaminants in at least one or more locations. These are the contaminants that should receive the most scrutiny in future investigations. Such scrutiny should include a thorough evaluation of all potentially exposed population groups and the evidence used to derive carcinogen slope factors and/or noncarcinogen reference doses. With few exceptions, all of the chemicals screened as potential contaminants of concern with environmental/ecological end points were also identified using human health risk end points.

1. INTRODUCTION

Operations and waste disposal activities at the Y-12 Plant, the Oak Ridge National Laboratory (ORNL), and the Oak Ridge Gaseous Diffusion Plant (ORGDP), located on the U.S. Department of Energy (DOE) Oak Ridge Reservation (ORR) in eastern Tennessee, have introduced a variety of airborne, liquid, and solid wastes into the surrounding environment (Rogers et al. 1988, 1989). Some of these wastes may affect off-site areas (i.e., areas beyond the ORR boundary) by entering local streams that ultimately drain into the systems of the Clinch and Tennessee rivers. Previously reported concentrations of radionuclides, metals, and organic compounds in water, sediment, and biota of the Clinch River and Watts Bar Reservoir suggest the presence of a variety of contaminants of possible concern to the protection of human health and the environment.

DOE has initiated a comprehensive waste management and environmental restoration effort to achieve the remediation of releases of hazardous substances, pollutants, or contaminants from the Oak Ridge Reservation (Jones et al. 1990). This effort has been undertaken in accordance with the draft Federal Facility Agreement (FFA) between the Environmental Protection Agency (EPA) Region IV, the State of Tennessee, and DOE. The FFA requires that the cleanup of ORR and environs be conducted in compliance with both the Resource Conservation and Recovery Act (RCRA) of 1976, as amended by the Hazardous and Solid Waste Amendments (HWSA) of 1984, and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986.

This preliminary screening of contaminants in the off-site surface water environment downstream of the DOE ORR represents part of the scoping phase of the Clinch River RCRA Facility Investigation (CRRFI), which is a component of the DOE Environmental Restoration Program at Oak Ridge. The primary objectives of CRRFI are to (1) define the nature and extent of off-site surface water contamination, (2) quantify the potential risk to human health and to the environment associated with off-site contamination, and (3) identify and preliminarily evaluate potential remediation alternatives.

The purpose of this preliminary screening analysis is to use existing data on off-site contaminant concentrations to identify and prioritize potential contaminants of concern for further evaluation and investigation. The primary objective of this screening analysis is to ensure that CRRFI sampling and analysis efforts focus on those contaminants that may possibly contribute to human health or environmental risk.

This report presents the results of contaminant screening using human health indices as an end point. A companion report by Suter (1990) addresses the screening results using environmental/ecological risk as an end point. A comparison of screening results using both human health and environmental risk end points is included in the discussion section of this report.

These analyses are preliminary scoping exercises based on existing data; they do not constitute a base-line risk assessment, and they are not intended to address issues regarding compliance with regulatory limits. The base-line risk assessment will include data obtained from the field sampling and sample analysis plan and will employ more realistic assumptions than those used for preliminary screening.

2. APPROACH

Two approaches are taken in this screening exercise (Table 2.1). The first approach is the use of conservatively biased calculations to identify contaminants and exposure pathways that should have a low priority for further analyses and data acquisition. Conservative calculations are unlikely to underestimate potential maximum exposures and thus may substantially overestimate the majority of actual exposures received by persons residing in the vicinity of the off-site environment. The second approach uses nonconservative calculations and assumptions to identify contaminants that should have highest priority for further evaluation and/or possible remediation. Nonconservative calculations provide a more realistic estimate and should not substantially overestimate maximum exposures to local population subgroups. These two screening approaches are intended to rapidly identify contaminants of concern and to guide the acquisition of more extensive data relevant to these contaminants.

The evaluation of the risk to humans and the environment will be an iterative process. The accuracy of the assessment will improve and the number of contaminants of concern should decrease with the acquisition of more complete data. Contaminants not identified as definitely low- or high-priority substances during the first iteration of screening are likely to be reclassified as additional data and information are obtained.

2.1 CONSERVATIVE SCREENING

Contaminant concentrations can be assigned a definite low priority for further study if a conservative estimate of health and environmental risk is sufficiently small. The conservative approach is based on the maximum reported concentration for a given contaminant and medium within a given reach of the off-site surface water environment. This extreme value is employed in accordance with recent EPA risk assessment guidance (USEPA 1989a) because existing data are not adequate for estimating an average concentration representative of possible lifetime exposure of a human receptor. The conservative approach also assumes, unrealistically, that individuals are exposed continuously to this maximum concentration for 70 years.

Concentrations of contaminants in environmental media for which data are unavailable are estimated using pathway models that employ conservative assumptions and transfer coefficients appropriate for screening calculations. When the concentration of a contaminant in a specific environmental medium is below the limits of analytical detection, models are used to conservatively estimate a concentration in that medium from concentrations reported in other media at or near the location of interest. In this case, concentrations are equal to the detection limits only when calculated concentrations exceed the reported limits. However, contaminants that are below the limits of detection *in all samples taken from all environmental media at a given location* are not included in these analyses. In these special cases, the limits of detection are evaluated separately assuming that the actual concentrations were equal to the lowest reported limits of detection.

Table 2.1 A comparison of conservative and nonconservative screening approaches

APPROACHES TO SCREENING	
Conservative Screening	Nonconservative Screening
Maximum concentration reported for a given reach used	Average of detected values reported for a given reach used
Models used to estimate concentrations in media that are not sampled or detected	Only measured concentrations in sediment, water, or fish are considered
Reasonable estimate of maximum diet and occupancy times assumed	Estimates of diet and occupancy times are generally a factor of 10 less than assumed for reasonable maximum
Human receptor exposed for 70 years	Probability of exposure period being less than 70 years considered in estimates of diet and occupancy times
Multiple pathway exposure considered	Multiple pathway exposure not considered
Exposure to dredged sediment considered separately from the consumption of water, fish, and irrigated agricultural produce	Dredging of sediment not considered Use of water for irrigation not considered
Calculated exposure should not underestimate actual maximum exposures	Calculated exposure should not overestimate potential maximum exposures
Screening approach most useful for identifying definitely low priority contaminants.	Screening approach most useful for identifying definitely and potentially high priority contaminants.

The models and parameter values employed in this analysis were obtained primarily from references that specifically propose methodologies for contaminant screening¹ (Hoffman et al. 1984, Travis et al. 1989, IAEA 1982, NCRP 1989). Where available screening procedures did not include recommended default values for a given contaminant, additional literature (Baes et al. 1984, Baes et al. 1989, Lappenbush 1988, Lyman et al. 1982) and site-specific data were evaluated, along with the use of professional judgment, to select values that would lead to a conservative estimate of exposure.

2.1.1 Exposure Pathways for Conservative Screening

For conservative screening, two exposure scenarios are considered separately. The first is a multiple pathway exposure scenario involving the ingestion of fish and water, and the consumption of vegetables, surface soil, milk, and meat that have been contaminated by river water used for irrigation. Inhalation of contaminants through wind resuspension of dust particles is also included as is the external exposure from gamma radiation emitted from radionuclides arising from irrigation water deposited onto surface soil.

The second scenario involves the assumption that sediment would be excavated through dredging and used as surface soil. For this dredging scenario, multiple exposures occur through incidental ingestion of surface soil; consumption of vegetables, milk, and meat produced on contaminated dredged sediment; and inhalation of resuspended dust particles, as well as external exposure to gamma radiation emitted from radionuclides in sediment. In this scenario, the contaminant concentration in surface soil is set equal to the maximum concentration reported in sediment regardless of the depth of the reported concentration. The aquatic and terrestrial pathways included in these scenarios are illustrated in Fig. 2.1.

The exposure pathways recommended by EPA for base-line risk assessment that have not been included in this conservative screening analysis are dermal contact with the contaminated medium and the inhalation of volatile organic compounds deposited either in sediment or soil (USEPA 1989a). Approaches for these pathways were under development at the time of preparation of this document (USEPA 1989b). These pathways are not expected to significantly impact the pathways and assumptions we have selected for conservative screening. However, a more detailed evaluation of these two exposure routes will be conducted during the first phase of the base-line risk assessment to ensure that a low priority of concern is not inadvertently assigned to a potential contaminant of concern.

For screening analyses of multiple pathway exposures, reasonable, maximum estimates of dietary habits and occupancy factors are used instead of absolute maximum values. These practices are made given that the maximum estimate for the use of a specific pathway is not likely to apply to a single individual exposed to all pathways simultaneously. The assumed dietary habits and occupancy times (usage factors) are given in Table 2.2.

¹ Many of the models and parameter values used for conservative screening were taken from screening methodologies developed for the National Council on Radiation Protection and Measurements (NCRP) by Task Group 6 of NCRP Scientific Committee 64. Two of the authors of the present document, F. O. Hoffman and B. G. Blaylock, serve as members of this Task Group. An NCRP report on screening methodologies for releases to the atmosphere, surface water, and groundwater is currently in preparation.

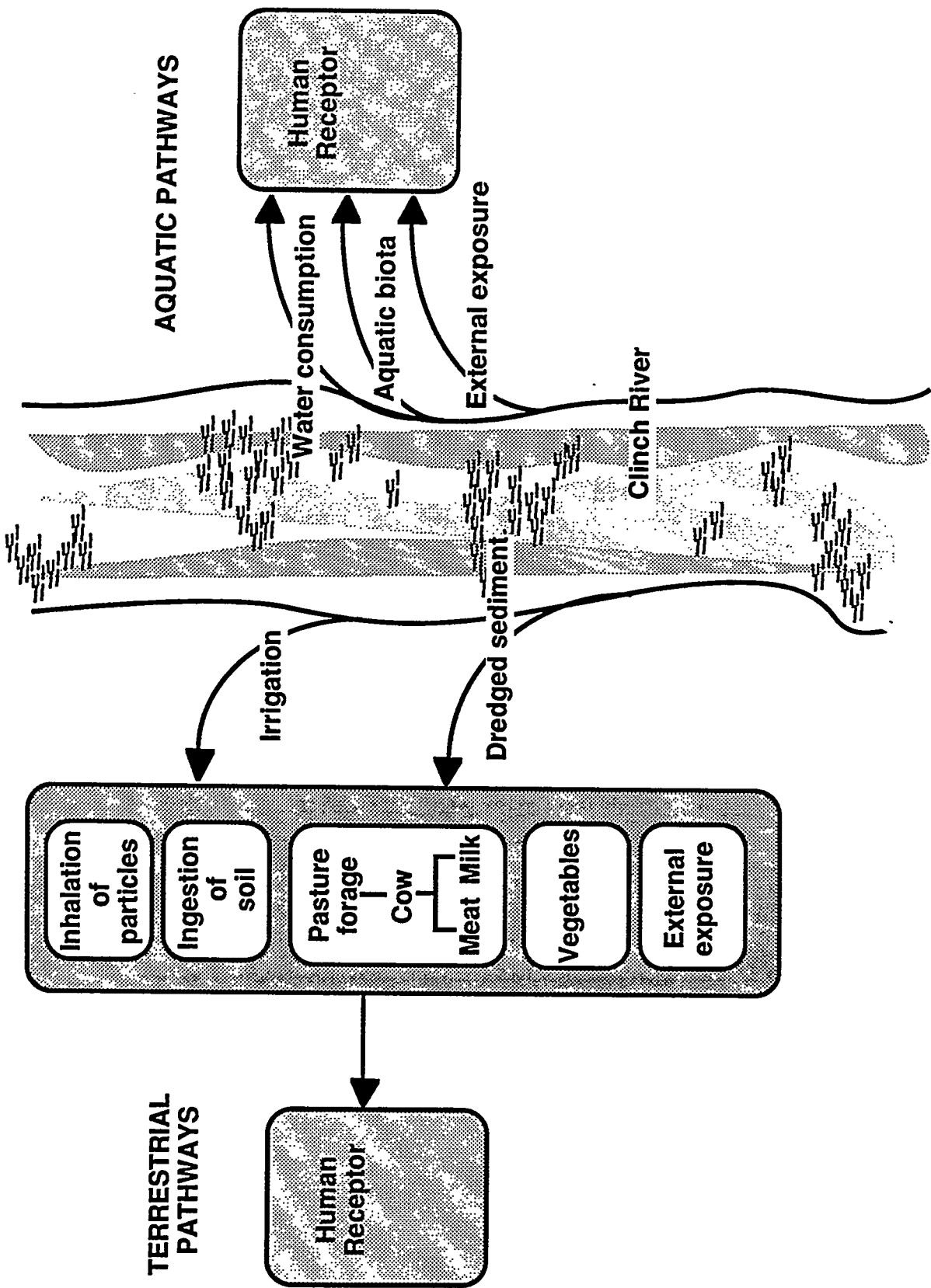


Fig. 2.1. Exposure pathways considered for the Clinch River off-site screening analysis

Table 2.2. Usage factors for conservative and nonconservative screening

Exposure route	Conservative screening	Nonconservative screening
Ingestion		
Aquatic biota	20 g d ⁻¹	3 g d ⁻¹
Drinking water	2 L d ⁻¹ ^a	0.25 L d ⁻¹
Terrestrial foods		
Milk	0.5 L d ⁻¹	NA ^b
Meat	200 g d ⁻¹	NA
Vegetables	200 g d ⁻¹	NA
Soil ingestion	0.1 g d ⁻¹	0.01 g d ⁻¹
Inhalation	23 m ³ d ⁻¹ ^c	NA
External exposure		
Irrigated soil	1000 h y ⁻¹	100 h y ⁻¹
Dredged sediment	1000 h y ⁻¹	NA

^aA 0.5 concentration reduction factor is used to account for consumption of fluids originating outside the region of contamination (NCRP 1984, Yang and Nelson 1984, Rupp 1980, Rupp et al. 1980, USEPA 1989b).

^bNA = not applicable for scenario considered.

^cA concentration reduction factor of 0.5 is used to account for time spent indoors or outside the region of contamination.

2.1.2 Criteria for Conservative Screening

Noncarcinogens with total screening indices <0.1, or carcinogens with total screening indices <10⁴, are designated through conservative screening as *definitely low priority contaminants*. Contaminants with noncarcinogen screening indices >1.0 or those with carcinogen screening indices >10³ are designated as potentially high priority for further evaluation and possible remedial action (Table 2.3). All contaminants not designated as definitely low priority substances are considered contaminants of concern subject to further evaluation.

2.1.3 Screening Indices for Carcinogens and Noncarcinogens

Screening indices (SIs) for carcinogens and noncarcinogens are calculated for contaminants of potential concern to human health. The screening index for carcinogens is a conservative estimate of exposure of the contaminant via ingestion or inhalation multiplied by an EPA-approved or -suggested "slope factor" for nonradioactive substances to indicate the potential lifetime risk of excess cancer (Appendix A). The slope factor provides an estimate of the lifetime risk of additional cancer incidence per unit exposure. For radioactive materials, exposure is translated into units of effective dose equivalent using factors of dose per unit intake or area deposition recommended for screening (NCRP in press) and multiplied by a weighted cancer incidence risk conversion factor of 5.7 x 10⁻² per Sievert based on the 1988 report of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR 1988, Stather et al. 1988, Clarke 1988)².

The screening index for noncarcinogens is a ratio that is composed of a conservatively biased estimate of ingestion or inhalation of the contaminant divided by a "reference dose (RfD) factor" (Appendix A). The reference dose is an EPA-approved noncarcinogenic contaminant exposure level below which adverse effects should not occur.

To be consistent with EPA recommendations for risk assessment (USEPA 1989a), screening indices for each contaminant are summed over all contaminants in a given pathway. For estimation of potential exposure to multiple pathways, screening indices are summed across pathways for each contaminant. Summation is conducted separately for carcinogens and noncarcinogens.

2.2 NONCONSERVATIVE SCREENING

The objective of nonconservative screening calculations is to rapidly identify contaminants and exposure pathways having the highest priority for further evaluation

² Since the completion of these screening calculations, interim radionuclide slope factors have become available from EPA (USEPA 1989d). A comparison has concluded that general agreement would be attained if the effective dose-equivalent and risk conversion factor used in this report were to be replaced with the EPA slope factor.

Table 2.3 Criteria for conservative and nonconservative screening of carcinogens and noncarcinogens

Screening Criteria	
Noncarcinogens	Carcinogens
Screening index (SI) = exposure divided by an RID	Screening index (SI) = exposure multiplied by a lifetime cancer slope factor
Conservative Estimate of Exposure	
SI < 0.1 <i>definitely low priority</i>	SI < 10^{-6} <i>definitely low priority</i>
SI ≥ 1.0 potentially high priority	SI $\geq 10^{-3}$ potentially high priority
Nonconservative Estimate of Exposure	
SI ≥ 1.0 <i>definitely high priority</i>	SI $\geq 10^{-3}$ <i>definitely high priority</i>
SI ≥ 0.1 potentially high priority	SI $\geq 10^{-4}$ potentially high priority
SI < 0.01 potentially low priority	SI < 10^{-7} potentially low priority

and/or remedial action consideration. Once a contaminant is assigned a definite high priority, an immediate review of the source data base and health advisory criteria should be conducted, including a review of the data used to derive EPA RfDs and carcinogen slope factors. These reviews may establish the need for immediate implementation of an interim remediation effort.

For nonconservative screening, average values of concentrations of contaminants in sediment, water, and fish are used. These concentrations, however, are averaged only among values reported above the limits of detection. Dietary habits and occupancy factors for potential receptors are based on assumed casual use of the medium of concern (Table 2.2). Multiple exposures to different contaminated media by the same individual are not considered; thus calculated screening indices for carcinogens and noncarcinogens are not summed across pathways. This approach is not likely to produce a large overestimate of potential maximum exposure, provided that fish, water, and sediment are actually utilized at the location of interest. Under some circumstances, nonconservative screening may underestimate maximum exposures to humans who are actually utilizing the Clinch River environment.

2.2.1 Exposure Pathways for Nonconservative Screening

The exposure pathways considered for nonconservative screening are only those for which concentrations above the limits of detection have been measured and reported. Exposure pathways are those limited to the ingestion of fish, water, and sediment as well as the external exposure from gamma radiation emitted from radioactive deposits in sediment. Models were not used to estimate concentrations in media that were not sampled, and models were not used to estimate concentrations of contaminants analyzed for and not detected.

2.2.2 Screening Indices for Carcinogens and Noncarcinogens

The screening indices for nonconservative screening are similar to those for conservative screening. For carcinogens, an estimate of exposure is multiplied by an EPA slope factor (or 5.7×10^2 per Sievert for radionuclides) to indicate the risk of excess cancer incidence during a 70-year lifetime. For noncarcinogens, an estimate of exposure is divided by an EPA-approved RfD (Appendix A). These slope factors and RfDs may themselves contain a large amount of conservatism in their derivation; therefore, detailed reevaluation of their derivation is warranted when nonconservative screening designates a contaminant as a high-priority substance.

2.2.3 Criteria for Nonconservative Screening

For nonconservative screening, contaminants that have noncarcinogen screening indices exceeding 1.0 or carcinogen screening indices exceeding 10^3 are designated as *definitely high priority* for remedial action consideration. Contaminants that have noncarcinogen screening indices exceeding 0.1 or carcinogen screening indices exceeding

10^4 are designated as potentially high priority substances. Because of the absence of conservatism in the exposure calculations, contaminants are only designated as potentially low priority substances when noncarcinogen screening indices are <0.01 or carcinogen screening indices are $<10^{-7}$ (Table 2.3).

3. DESCRIPTION OF SURFACE WATER REACHES AND DEVELOPMENT OF SOURCE TERM DATA BASE

3.1 RIVER AND STREAM REACHES

The Clinch River off-site area to be investigated in CRRFI was divided into units or reaches based upon the proximity to known contaminant release points from DOE facilities and other potential sources of pollution. These stream and river reaches are shown in Figs. 3.1 and 3.2. A description of the reaches and reach boundaries and the facilities releasing effluents that eventually enter a particular reach are given in Table 3.1.

Effluents containing contaminants from the Oak Ridge facilities (ORNL, Y-12, and ORGDP) are released into East Fork Poplar Creek, Bear Creek, Poplar Creek, White Oak Creek, and the Clinch River. Melton Hill Reservoir, Reach 1, receives effluents from Y-12's fly ash pond via McCoy Branch and from a waste disposal site in Kerr Hollow via Scarboro embayment. Effluents from ORNL and associated waste management sites enter streams that drain White Oak Creek watershed and are transported downstream to White Oak Lake where DOE's control of the effluents is lost at White Oak Dam. Contaminants from ORNL are associated primarily with Reach 2 and downstream reaches. Effluents from Y-12 and associated facilities are released into Bear Creek and East Fork Poplar Creek, both of which will be subject to separate RCRA facility investigations (RFIs). For purposes of CRRFI, the first surface water reach potentially affected by Y-12 plant effluents begins at the confluence of East Fork Poplar Creek with Poplar Creek (Reach 3). Effluents from ORGDP are also released into Poplar Creek (Reach 3) and the Clinch River above and below the confluence of Poplar Creek, Reaches 2 and 4, respectively. Three reaches were used in the screening analyses as reference reaches: Norris Reservoir (Reach 10), Poplar Creek above the confluence of East Fork Poplar Creek (Reach 13), and the Tennessee River from the confluence with the Clinch River to Fort Loudoun Dam (Reach 18). Reference reaches do not receive effluents from DOE Oak Ridge facilities; however, they may be recipients of industrial wastes from other sources. Based on the data available, Norris Reservoir (Reach 10) appears to be the least polluted of the reference reaches.

3.2 SOURCES OF INFORMATION

Information used in the screening analyses included a compilation of existing data from previous monitoring programs, surveys, and scientific studies. The information was evaluated for its relevance to a screening analysis, and data for three environmental media (water, fish, and sediment) were compiled into a data base. The data base used for screening included approximately 9,000 values for contaminants in sediment, 9,000 for fish, and 25,000 for water. Many of these were organic chemicals that were below the limits of detection. These data were summarized to obtain source terms for the environmental pathway models to predict the exposure of humans and biota to contaminants. The source term data consisted of maximum and mean concentrations of organic and inorganic (metals) compounds and radionuclides in the three environmental media. Sources of the information for the different environmental media are listed in Table 3.2. Screening of these data is necessary to determine sampling priorities and to focus the efforts of the base-line risk analysis.

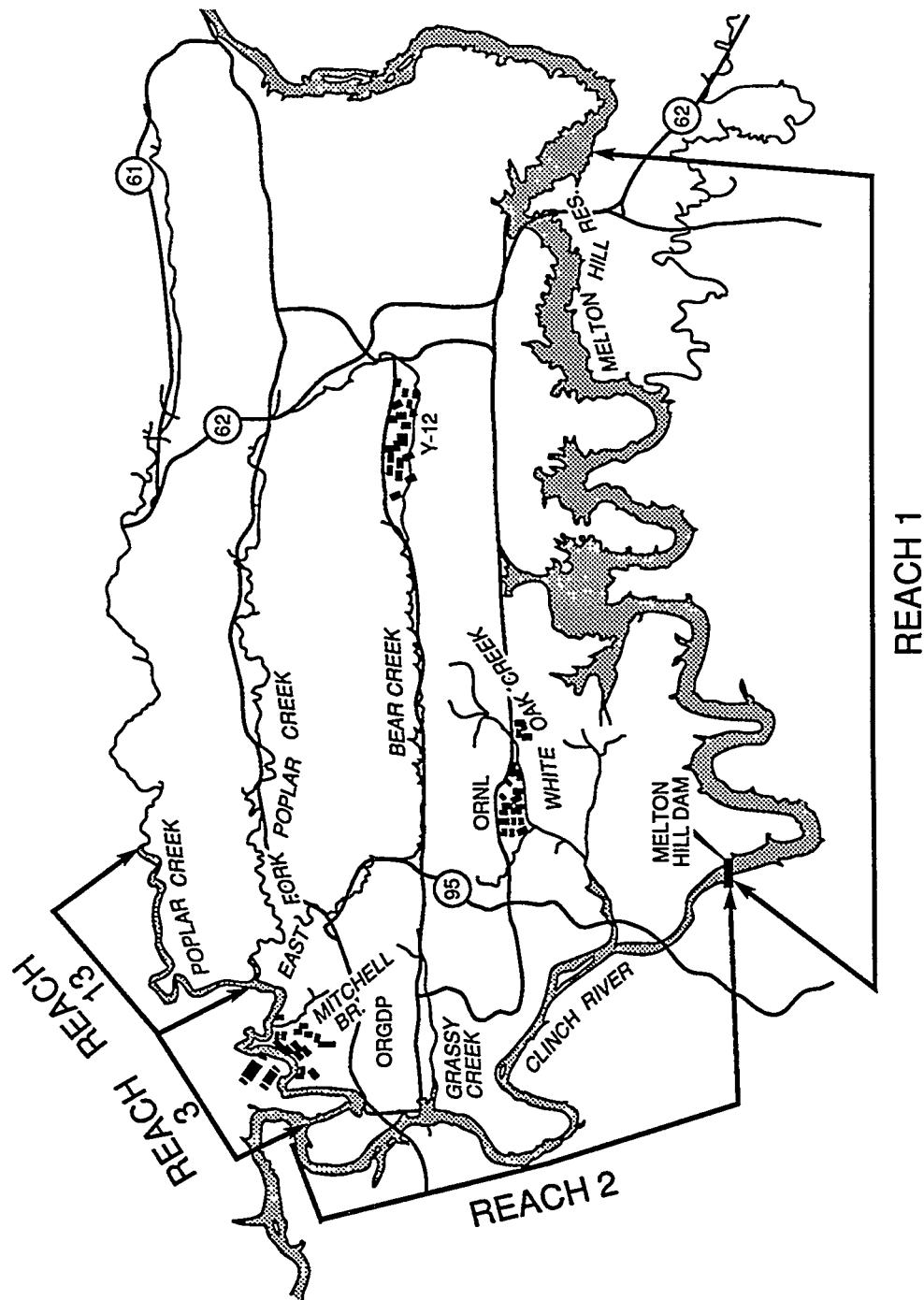


Fig. 3.1. REACH 1 on Melton Hill Reservoir, REACH 2 on the Clinch River, and REACH 3 on Poplar Creek receive effluents from the Oak Ridge facilities. REACH 13 on Poplar Creek is a reference reach

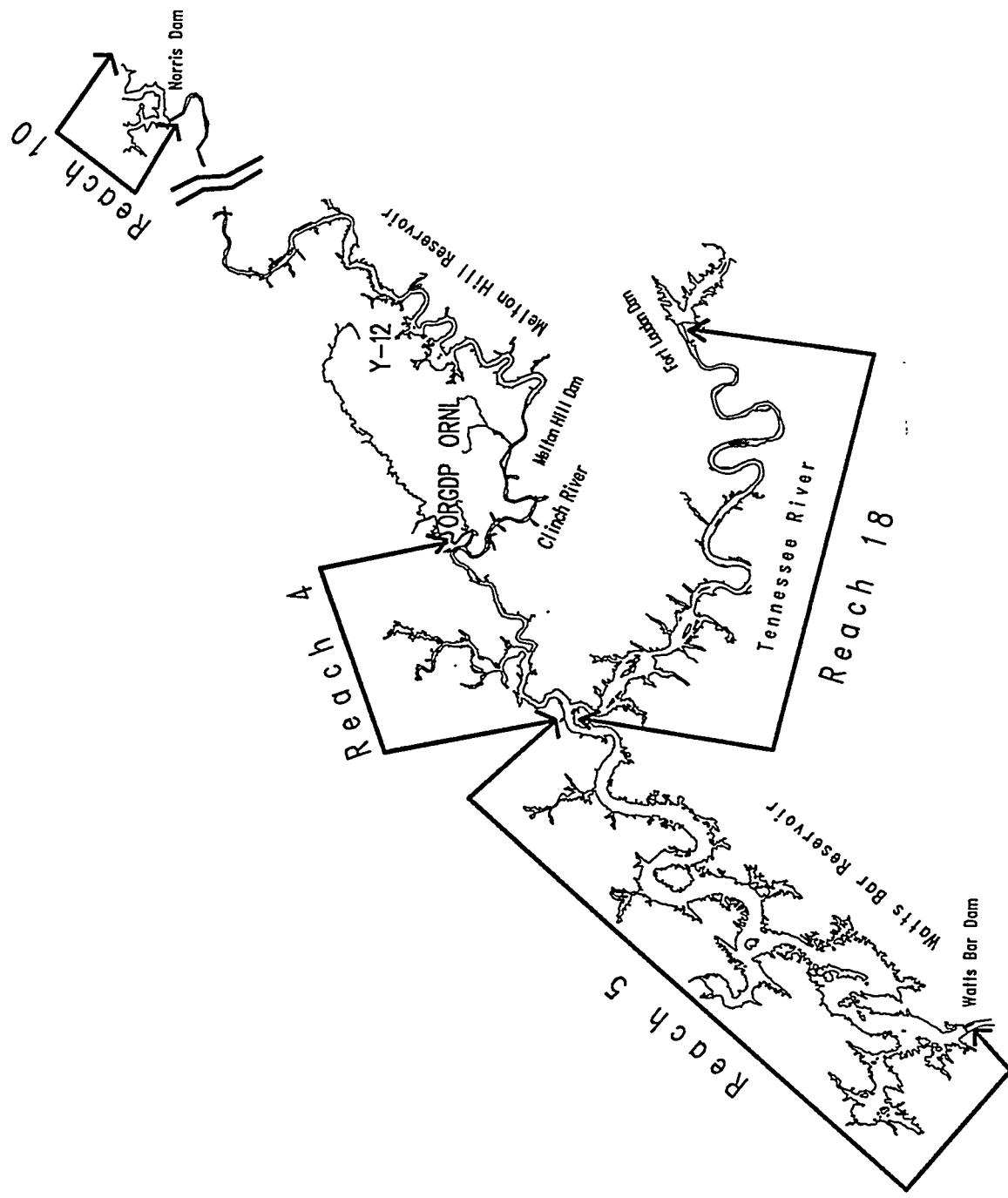


Fig. 3.2. Reach 4 on the Clinch River and Reach 5, Watts Bar Reservoir, are downstream from the Oak Ridge Reservation and receive effluents from all Oak Ridge facilities. Reach 10, Norris Reservoir, and Reach 18 on the Tennessee River are reference reaches

**Table 3.1. River and stream reaches and associated facilities
to be evaluated in the Clinch River RCRA
Facility Investigation**

Reach number	Reach name (description) and associated facilities	River or stream mile
1	Melton Hill Reservoir (Y-12)	CRM ^a 23.1-42.0
2	Clinch River from Poplar Creek confluence to Melton Hill Dam (includes White Oak Creek embayment) (ORNL and Y-12)	CRM 12.5-23.1
3	Poplar Creek from mouth to confluence with East Fork Poplar Creek (ORGDP and Y-12)	PCM 0.0-5.4
4	Clinch River from mouth to confluence with Poplar Creek (ORNL, Y-12, and ORGDP)	CRM 0.0-12.0
5	Watts Bar Reservoir from Watts Bar Dam to confluence with Clinch River (ORNL, Y-12, and ORGDP)	TRM 529.9-567.8
10	Norris Reservoir (reference reach)	CRM 79.8-88.8
13	Poplar Creek above confluence with East Fork Poplar Creek (reference reach)	PCM 5.4-13.0
18	Tennessee River from confluence with Clinch River to Fort Loudon Dam (reference reach)	TRM 567.8-602.3

^aCRM = Clinch River mile,
PCM = Poplar Creek mile,
TRM = Tennessee River mile.

Table 3.2. Sources of data on contaminant concentrations in fish, water, and sediment in off-site surface water used to develop a data base for screening analyses

Data source	Environmental media ^a		
	Fish	Water	Sediment
Ecological Studies (Loar et al. 1981)	M,R	—	—
Clinch River Sediment Study (Oakes et al. 1982)	—	—	R
STORET, TVA (STORET, 1985) ^b	M,O,R	M,O,R	M,R
Instream Contaminant Study (TVA 1985 a,b)	M,O,R	—	M,O,R
Sediment Contamination in Streams (Ashwood et al. 1986)	—	—	M,O,R
Environmental Surveillance Report (Includes NPDES ^c and water quality monitoring data) (Rogers et al. 1987,1988)	M,O,R	M,O,R	M
ORNL Biological Monitoring and Abatement Program (Loar et al. 1987, Loar 1988)	M,O,R	—	—
Watts Bar Reservoir Scoping Study (Olsen et al. 1990)	—	—	M,R

^aM = metals,
O = organic,
R = radionuclides.

^bSTORET 1985 (TVA data from 1982-1989).

^cNPDES = National Pollution Discharge Elimination System.

3.3 DATA SUMMARIES

The data summaries developed for the screening analyses are given in tables in Appendix B. The maximum and mean values for concentrations of organics, inorganics, and radionuclides are given for fish, water, and sediment for each river and stream reach. Maximum values consisted of either the maximum measured contaminant concentrations that exceeded the limits of detection or the limits of detection for contaminants that were analyzed for but not detected. Mean values consisted of the means of measured values greater than the limits of detection. Mean values for sediment were for surface-sediment samples only. The maximum and mean concentrations for organic contaminants in sediment, fish, and water for each stream or river reach are listed in Tables B1 and B2, respectively. Maximum and mean concentrations for inorganics (metals) in sediment, fish, and water for each stream or river reach are in Tables B3 and B4, respectively. Maximum and mean values for radionuclides are listed in Tables B5 and B6, respectively.

Environmental media were analyzed for many contaminants that were not detected. These data are analyzed in Appendix E. Table E1 lists the minimum detection limits reported for inorganic compounds from all reaches for sediment, fish, and water. The minimum detection limits reported for organics are given in Table E2 and for radionuclides in Table E3.

4. RESULTS

The complete results obtained from conservative and nonconservative screening are reported in Appendixes C and D, respectively. Fifteen inorganic chemicals, 16 organic chemicals, and 11 radionuclides were identified as potentially high priority contaminants of concern in one or more reaches of the Clinch River environment. Of these, arsenic in the water of Reach 1, thallium in fish of Reach 1, and ^{137}Cs in the sediment of Reach 2 have been identified as definitely high priority substances.

Because of the use of maximum reported concentrations and cancer screening limits of 10^{-6} for carcinogens and 0.1 for noncarcinogens, few substances were identified through conservative screening as definitely low priority substances. Most contaminants listed as definitely low priority substances were classified assuming that dredging of sediment would not occur. No reach was identified as either a definitely or potentially low priority.

The conservative practice [as recommended by EPA (USEPA 1989a)] of summing screening indices for carcinogen and noncarcinogen contaminants did not result in a substantial difference between the total screening index for a given reach summed over all contaminants (Appendix C: Tables C1a and b, and Tables C5a and b; Appendix D: Tables D1 and D2) and the maximum index for a specific contaminant (Appendix C: Tables C2a through C4b, and Tables C6a and C7b; and Appendix D: Tables D3 through D7). In all but two cases, this difference was well within a factor of 3 with the majority being within a factor of 2. The largest difference, a factor of 5, occurred for assumed dredging of sediment at Reach 3.

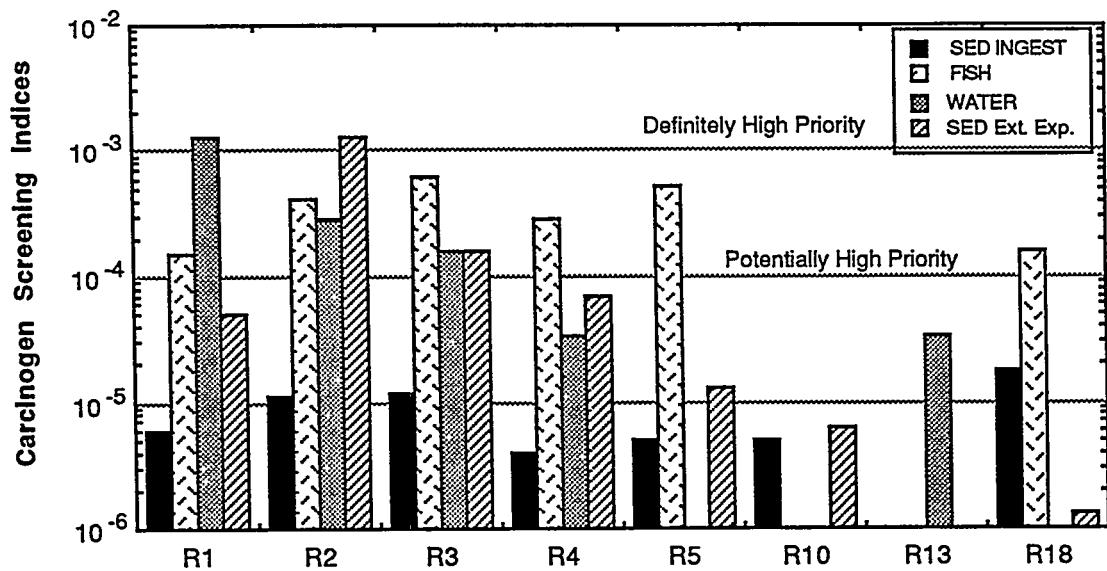
The screening indices reported in Appendices C and D are based on health risk end points. Nevertheless, these results should not be equated with those of a base-line human health risk assessment. The indices produced through conservative screening are intended not to underestimate potential maximum exposures, and thus they may be a gross overestimation of actual exposures. The indices produced through nonconservative screening are intended not to overestimate potential maximum exposures, and thus are lower than would be produced using recommended EPA risk assessment procedures (USEPA 1989a) for estimating maximum exposures.

The following sections summarize the results obtained through nonconservative and conservative screening. Because of the importance of nonconservative screening in identifying definitely high and potentially high priority contaminants, these results are presented first.

4.1 HIGH-PRIORITY CONTAMINANTS IDENTIFIED THROUGH NONCONSERVATIVE SCREENING

Nonconservative screening has identified definitely high priority contaminants in Reaches 1 and 2 and potentially high priority contaminants in Reaches 1 through 5 (Figs. 4.1A and 4.1B, and Table 4.1). Within these reaches, a total of 10 contaminants (i.e., 4 inorganic chemicals, 3 organic chemicals, and 3 radionuclides) have been identified as

A. Carcinogens



B. Non-carcinogens

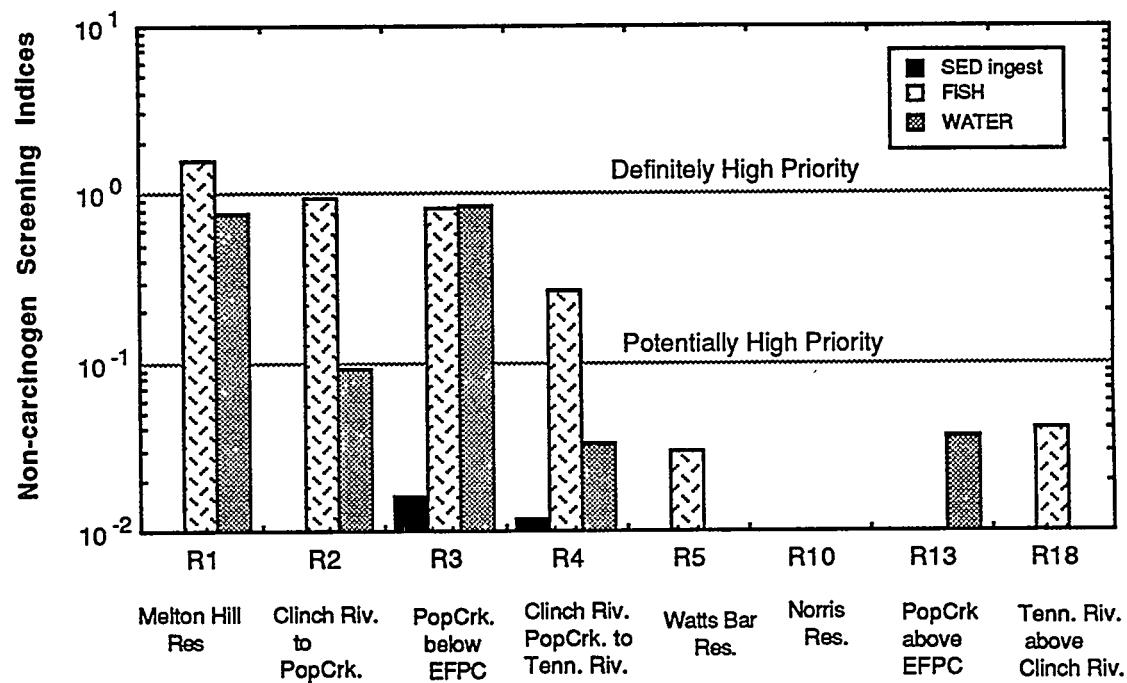


Fig. 4.1. A comparison of pathway totalled screening indices by reach for carcinogens (Fig. 4.1A) and non-carcinogens (Fig. 4.1B) using non-conservative estimates of exposure.

Table 4.1. Contaminants assigned either a definitely or potentially high priority through nonconservative screening

Contaminant	Reach	Pathway	Toxicity type
Definite High Priority Substances^a			
Inorganic chemicals			
Arsenic	1	Water	Carcinogen(A) ^{b c}
Thallium	1	Fish ^d	Noncarcinogen (UF=3000) ^e
Organic chemicals (none)			
Radionuclides			
¹³⁷ Cs	2 ^f	Sediment/external exposure	Carcinogen(A)
Potential High Priority Substances^g			
Inorganic chemicals			
Antimony	1	Fish ^d	Noncarcinogen (UF=1000)
	2	Water	
	3	Water and fish ^d	
Arsenic	2	Water	Carcinogen (A)
Thallium	1	Fish	Noncarcinogen (UF=3000)
	3	Fish	
Uranium ^h	3	Water	Noncarcinogen (UF=1000)
Organic chemicals			
PCB-1254	1	Fish	Carcinogen (B2) ^c
	3	Fish, water	
	4	Fish	
	5	Fish	
	18	Fish	

Table 4.1 (continued)

Contaminant	Reach	Pathway	Toxicity type
Organic chemicals (continued)			
PCB-1260	1	Fish	Carcinogen (B2)
	3	Fish	
	4	Fish	
	5	Fish	
Chlordane	1	Fish	Noncarcinogen
	2	Fish	(UF=1000)
	4	Fish	
Radionuclides			
¹³⁷ Cs	2 ⁱ	Sediment/external exposure	Carcinogen (A)
	4	Sediment/external exposure	
³ H	2	Water	Carcinogen (A)
⁶⁰ Co	2	Sediment/external exposure	Carcinogen (A)
²³⁴ Pa	3	Sediment/external exposure	Carcinogen (A)
⁹⁰ Sr	2	Water	Carcinogen (A)
¹⁵² Eu	2	Sediment/external exposure	Carcinogen (A)
¹⁵⁴ Eu	2	Sediment/external exposure	Carcinogen (A)

^aCarcinogen screening index $\geq 10^3$; noncarcinogen screening index ≥ 1.0 .

^bUnder EPA review.

^cA = sufficient human evidence for carcinogenicity,

B2 = sufficient evidence in animals but none or inadequate data for humans.

^dPotential artifact, few positive samples reported.

^eUF = uncertainty factor used by EPA to derive a RfD for noncarcinogens.

^fAveraged for six samples taken in White Oak Lake embayment (public access not permitted, posted area).

^gCarcinogen screening index $\geq 10^4$; noncarcinogen screening index ≥ 0.1 .

^hAssumed as uranium salt.

ⁱAveraged for 32 surface sediment samples taken throughout Reach 2.

either definitely or potentially high priority. Of these, arsenic in water samples from each 1 and ^{137}Cs in sediment at Reach 2 have been classified as definitely high priority contaminants. Both of these contaminants are designated as Group A carcinogens by EPA, meaning that sufficient human data support classification as a carcinogen. Thallium in fish of Reach 1 is also classified as a definitely high priority contaminant, but this classification may be an artifact given that only 4 of 26 samples were reported at or above the limit of detection. Thallium is a noncarcinogen; large safety factor ($\text{UF}=3000$) was applied to account for uncertainty in the derivation of its RfD by EPA (USEPA 1989d).

It is likely that the nonconservative calculation of exposure to arsenic in water at Reach 1 (Appendix D) is an overestimate of actual exposures. Arsenic concentrations on which the exposure estimates were based were derived from samples obtained from the National Pollution Discharge Elimination System (NPDES) station located on the ORR below Roger's Quarry on McCoy Branch, a small stream entering the Clinch River at river mile 37.6. Water at that location is not presently used for drinking, and dilution in the Clinch River is considerable. Arsenic concentrations near water intakes for treatment facilities downstream from this reach are much lower (by approximately one order of magnitude), and treatment processes should effectively remove such chemicals from the water prior to human consumption.

The external exposure to sediments containing ^{137}Cs in Reach 2 is also a likely overestimate because the high sediment concentrations are located in the embayment of White Oak Creek downstream from White Oak Lake. This is a posted area and public access is restricted. Potentially high priority screening indices ($\sim 10^4$) could also occur in Reach 2 from external gamma radiation from ^{137}Cs in the 0800 Area of the Oak Ridge Reservation at Clinch River mile 20.5 (Fritzsche 1987, Rogers et al. 1989a). This stretch of river is not restricted to public access, although the source of radioactivity is on land within a secured area adjacent to the river.

Further analyses of samples from these reaches and more accurate assessments of the potential risk of exposure via all possible pathways is warranted to guide decisions about remedial action alternatives. Risk estimates may be revised in either direction as a result of a more detailed investigation that would take into account additional pathways of exposure and more realistic assumptions about the potential for individuals to be maximally exposed (USEPA 1989a).

4.2 POTENTIALLY HIGH PRIORITY CONTAMINANTS IDENTIFIED THROUGH CONSERVATIVE SCREENING

The use of maximum reported concentrations in water, fish, or sediment as well as the application of conservatively biased model calculations to estimate exposures resulting from possible irrigation and sediment dredging produce a much larger listing of potentially high priority contaminants than was produced with nonconservative screening (Table 4.2). The majority of the potentially high priority contaminants are located in those reaches subjected to the most frequent sampling, namely Reaches 1, 2, 3, 4 and 5. Among these reaches, Reach 3 contains the most contaminants of potentially high priority, of which 13 are inorganic chemicals, 16 are organic chemicals, and 11 are radionuclides. Most of the radionuclides of potentially high priority are found in Reach 2, which is to be expected because of releases from waste management areas surrounding Oak Ridge National

Table 4.2. Contaminants assigned a potentially high priority through conservative screening^a

Contaminant	Reach	Pathway	Toxicity type
Inorganic chemicals			
Arsenic	1	Water, veg(I ^b), veg(D ^c)	Carcinogen (A) ^{d e}
	2	Water, veg(I), soil/ing(I), veg(D)	and noncarcinogen
	3	Water, veg (I), veg(D)	(UF=1)
	4	Veg(D)	
	5	Veg(D)	
	10	Veg(D)	
	13	Veg(D), fish,	
	18	Veg(D)	
Antimony	1	Fish	Noncarcinogen
	2	Fish, veg (I)	(UF=1000) ^f
	3	Fish, water, meat(I), veg(I), soil/ing(I), veg(D), meat (D)	
Barium	4	Water,veg(I),veg(D)	Noncarcinogen (UF=100)
Beryllium	1	Veg(D)	Carcinogen(B2)
	2	Veg(D), meat(D)	
	3	Veg(D), meat(D)	
	4	Veg(D)	
	5	Veg(D)	
Boron	3	Water, meat(I), milk(I), veg(I), veg(D), milk(D)	Noncarcinogen (UF=100)
	4	Water, milk(I), meat(I), veg(I), veg(D), milk(D)	
Cadmium	2	Veg(D), milk(D)	Noncarcinogen
	3	Water, milk(I), veg (I), veg(D), milk(D)	(UF=10)
	4	Veg(D)	

Table 4.2 (continued)

Contaminant	Reach	Pathway	Toxicity type
Inorganic chemicals (continued)			
Chromium ^g	1 2 3 4 5 10 18	Veg(D), meat (D) Veg(D), milk(D), meat(D) Veg(D), milk(D), meat(D) Meat (I), veg(D), milk(D), meat(D) Veg(D), milk(D), meat(D) Meat (D) Veg(D), milk(D), meat(D)	Noncarcinogen (UF=500)
Mercury	1 3 4 5 18	Fish, veg(I), meat (I) Fish, veg(D), milk(D), meat(D) Fish, veg(D), milk(D), meat(D) Veg(D), milk(D), meat(D) Veg(D), milk(D), meat(D)	Noncarcinogen (UF=10)
Nickel	3 4 13	Water, veg(I), veg(D), milk(D), meat(D) Veg(D) Veg(D)	Noncarcinogen (UF=300)
Selenium	1 2 3 4 5	Milk (I), meat(I), meat(D) Meat(I), veg(D), milk(D), meat(D) Veg(D), milk(D), meat(D),soil/ing(D) Meat(I), veg(D), milk(D), meat(D) Meat(I), meat (D)	Noncarcinogen (UF=15)
Silver	2 3 4	Veg(D), milk(D), meat(D) Milk(I), milk(D) Veg(D), milk(D)	Noncarcinogen (UF=2)
Thallium	1 2 3	Fish, veg(D), milk(D), meat(D) Fish, veg(D), milk(D), meat(D) Fish, veg(D), milk(D), meat(D)	Noncarcinogen (UF=3000)
Uranium ^h	2 3	Veg(D), Fish, water, meat(I), milk(I), veg(I), soil/ing(I), Veg(D), milk(D), meat(D)	Noncarcinogen (UF=1000)
Vanadium ⁱ	4	Fish, veg(D), meat(D)	Noncarcinogen (UF=100)

Table 4.2 (continued)

Contaminant	Reach	Pathway	Toxicity type
Inorganic chemicals (continued)			
Zinc	1	Veg(D), milk(D), meat(D)	Noncarcinogen
	2	Veg(D), milk(D), meat(D)	(UF=10)
	3	Meat(I), veg(D), milk(D), meat(D)	
	4	Veg(D), milk(D), meat(D)	
	5	Veg(D), milk(D), meat(D)	
	13	Milk(D), meat(D)	
Organic chemicals			
Chlordane	1	Fish, veg(I), veg(D)	Noncarcinogen
	2	Fish, veg(I), veg(D)	(UF=1000)
	4	Fish, water, veg(I), veg(D)	
PCB-1254	1	Fish, veg(D), milk(D), meat(D)	Carcinogen (B2)
	2	Fish, veg(D), milk(D), meat(D)	
	3	Fish, water, meat(I), milk(I), veg(I)	
	4	Fish	
	5	Fish	
	18	Fish, milk(D), meat(D)	
PCB-1260	1	Fish	Carcinogen (B2)
	2	Fish, veg(D), milk(D), meat(D)	
	3	Fish	
	4	Fish	
	5	Fish	
Vinyl Chloride ^{i,j}	3	Veg(I)	Carcinogen(A)
Anthracene ^k	3	Fish, veg(D)	Carcinogen(B2)
	4	Fish, water, veg(I), veg(D), milk(D), meat(D)	
Benzo(a)anthracene ^{i,j}	3	Fish, veg(D), milk(D), meat(D)	Carcinogen(B2)
	4	Fish, veg(D), milk(D), meat(D)	

Table 4.2 (continued)

Contaminant	Reach	Pathway	Toxicity type
Organic chemicals (continued)			
Chrysene ^{i,j}	3	Fish, veg(D), milk(D), meat(D)	Carcinogen(B2)
	4	Fish, veg(D), milk(D), meat(D)	
Fluoranthene ^j	1	Fish, veg(D)	Carcinogen(B2)
	3	Fish, veg(D), milk(D), meat(D)	
Methylene chloride ^k	3	Veg(I)	Carcinogen(C)
Phenanthrene ^j	3	Fish, veg(D)	Carcinogen(B2)
	4	Fish, veg(I), veg(D), milk(D), meat(D)	
Pyrene ^j	3	Fish, veg(D), milk(D), meat(D)	Carcinogen(B2)
	4	Fish, water, veg(I), veg(D), milk(D), meat(D)	
<i>trans</i> -1,3-dichloropropene ^k	3	Water, veg(I)	Noncarcinogen (UF=10,000)
Carbon tetrachloride ^k	3	Veg(I)	Noncarcinogen (UF=1000)
<i>trans</i> -1,2-dichloroethene ^k	3	Veg (I)	Noncarcinogen (UF=1000)
4,6-Dinitro-ortho-cresol	1	Fish, water, veg(I), veg(D)	Noncarcinogen
	3	Fish, water, veg(I), veg(D)	(UF=1000)
Bis(2-ethylhexyl)phthalate	3	Veg(D)	Noncarcinogen (UF=1000)
Radionuclides			
⁹⁰ Sr	2	Water, veg(I)	Carcinogen (A)
		Veg(D), milk(D), meat (D), sed/ext (D)	
	4	Veg(D), milk(D)	
¹³⁷ Cs	2	Meat(I), milk(I), soil/ext(I)	Carcinogen (A)
		Veg(D), soil/ing(D), milk(D), meat(D), sed/ext(D)	
	4	Veg(D), milk(D), meat(D), sed/ext(D)	
	5	Veg(D), milk(D), meat(D), sed/ext(D)	

Table 4.2 (continued)

Contaminant	Reach	Pathway	Toxicity type
Radionuclides (continued)			
³ H	2	Water	Carcinogen (A)
⁶⁰ Co	2	Veg(D), milk(D), meat(D), sed/ext(D)	Carcinogen (A)
	3	Sed/ext(D)	
	4	Sed/ext(D)	
	5	Sed/ext(D)	
¹⁵⁴ Eu	2	Sed/ext(D)	Carcinogen(A)
¹⁵² Eu	2	Sed/ext(D)	Carcinogen(A)
²⁴¹ Am	2	Veg(D)	Carcinogen (A)
	4	Veg(D)	
²³⁹ Pu	2	Veg(D)	Carcinogen (A)
²³⁴ Pa	3	Sed/ext(D)	Carcinogen (A)
²⁴⁴ Cm	2	Veg(D)	Carcinogen (A)
²³⁸ U	2	Veg(D), meat(D)	Carcinogen (A)
	3	Veg(I), meat(I), veg(D), meat(D)	
	4	Veg(D), meat(D), sed/ext(D)	

^aCarcinogen screening index $\geq 10^3$, noncarcinogen screening index ≥ 1.0 ; exposures in all media based on maximum concentrations reported in fish, sediment, or water.

^bI = exposures estimated assuming water irrigation.

^cD = exposures estimated assuming sediment dredging.

^dUnder EPA review.

^eA = sufficient human evidence for carcinogenicity,

B1 = evidence for carcinogenicity in humans limited,

B2 = sufficient evidence in animals but none or inadequate data for humans,

C = limited animal data and inadequate human data.

^fUF = uncertainty factor used by EPA to derive a RfD for noncarcinogens.

^gAssumed as chromium VI.

^hAssumed as uranium salt.

ⁱScreening indices based on one sample.

^jSlope factor for screening only, based on limited data.

^kVolatile organic compounds.

Laboratory.

The chemicals of potentially high priority, found in at least five of the eight reaches sampled, were arsenic, beryllium, chromium, mercury, zinc, selenium, PCB-1254, and PCB-1260. In addition, arsenic, chromium, mercury, nickel, zinc, and PCB-1254 were found at potentially high priority levels in sediment and other media sampled in reference reaches (10, 13, or 18). These reaches do not receive discharges from DOE/Oak Ridge Operations.

The highest estimated exposures from the inorganic chemicals were generally the result of assumed dredging of sediment and its possible use as a source of agricultural soil from which crops, milk, and meat were produced. At the present time, this assumed pathway is not a common practice in the reaches of concern, and current environmental regulations may prevent such practices from occurring in the future.

With the exception of the PCBs, most of the potentially high priority organic contaminants in Reaches 3 and 4 are polycyclic aromatic hydrocarbons (PAHs) and commercial pesticides. These chemicals may originate from industrial and agricultural sources other than DOE operations. In addition, the carcinogen slope factor adopted in this study [$11.5(\text{mg/kg/d})^{-1}$] is used for screening purposes only. Slope factors for PAHs have been removed from current EPA listings because of insufficient data (USEPA 1989d). Some of the organic chemicals listed as potentially high priority may be readily metabolized or are volatile and thus should not accumulate in vegetation, fish, or the food products of grazing animals. Further evaluation of these substances, however, should include additional processes of exposure that have not been included in this screening approach. These processes are exposure to metabolites of parent organic compounds, skin absorption from dermal contact, and inhalation of vapors.

Further analysis of exposures to the potentially high priority substances identified through conservative screening is likely to demonstrate that the risk to human health is of much lower priority because of the large amount of intentional bias applied in conservative screening. In general, substituting average concentrations for maximum concentrations would reduce exposure estimates by about one order of magnitude. Further reductions in the estimate of exposure might be realized with the application of more realistic parameter values derived specifically for the actual conditions of human exposure in the off-site environment (i.e., exposure periods less than 70 years, site-specific estimate of dietary habits).

4.3 DEFINITELY LOW PRIORITY CONTAMINANTS IDENTIFIED THROUGH CONSERVATIVE SCREENING

A primary objective of screening is to reduce the number of contaminants included in the CRRFI sampling and analysis effort and in the base-line risk assessment by identifying definitely low priority contaminants. The assumptions used for conservative screening, however, resulted in only 5 inorganic chemicals and 16 radionuclides classified as definitely low priority at one or more reaches over all pathways (Table 4.3). Most of these, however, were classified as definitely low priority substances only under the condition that dredging of sediment would not occur.

Because health risks for carcinogens and noncarcinogens are summed among contaminants in a given reach, within and across exposure pathways, respectively, no reach could be given a definitely low priority, including those reaches assumed to be reference

Table 4.3. Contaminants assigned a definitely low priority through conservative screening^a

Contaminant	Reach	Pathway	Toxicity type
Inorganic chemicals			
Cyanide	1 2 13	All All All	Noncarcinogen (UF=1000) ^b
Cadmium	18	All	Noncarcinogen (UF=10) ^c
Nickel	1 5	All except veg(D) and milk(D) All except veg(I)	Both
Selenium	5	All except dredging pathways	Noncarcinogen (UF=15)
Mercury	10	All except dredging pathways	Noncarcinogen (UF=10)
Organic chemicals (None)			
Radionuclides			
⁶⁰ Co	1 4	All except dredging pathways All except dredging pathways	Carcinogen (A) ^d
⁸⁹ Sr	1 3	All except veg(I) and dredging All except dredging pathways	Carcinogen(A)
⁹⁹ Tc	1 3 4	All All except veg(I) All except veg(I)	Carcinogen (A)
¹³⁴ Cs	3	All except dredging pathways	Carcinogen (A)
¹³⁷ Cs	3 10 18	All except fish ingestion and Dredging pathways All except fish ingestion and dredging All except dredging	Carcinogen (A)

Table 4.3 (continued)

Contaminant	Reach	Pathway	Toxicity type
Radionuclides (continued)			
²³³ Pa	3	All	Carcinogen (A)
²³⁴ Pa	1 2 3	All except dredging pathways All except dredging pathways All except dredging pathways	Carcinogen (A)
²³² Th	1	All except veg(I) and dredging	Carcinogen (A)
²³⁴ Th	2 3 4	All except dredging pathways All except dredging pathways All except dredging pathways	Carcinogen (A)
²³⁵ U	1 2	All except dredging pathways All except dredging pathways	Carcinogen (A)
²³⁶ U	2 4	All All	Carcinogen (A)
²³⁸ U	1 2	All except veg(I) and dredging All except veg(I) and dredging	Carcinogen (A)
²³⁸ Pu	1 3 4 5	Dredging pathways only All All except dredging pathways All except dredging pathways	Carcinogen (A)
²³⁹ Pu	1 3 5	All except dredging pathways All except dredging pathways All except dredging pathways	Carcinogen (A)
²⁴¹ Am	3 10	All except dredging pathways All except dredging pathways	Carcinogen (A)
²⁴⁴ Cm	3 10	All except dredging pathways All	Carcinogen (A)

^aCarcinogen screening index <10⁻⁶, noncarcinogen screening index <0.1; exposures in all media based on maximum concentrations reported in fish, sediment, or water.

^bUF = uncertainty factor used by EPA to derive a RfD for noncarcinogens.

^cListed as both a carcinogen and noncarcinogen; however, at a cancer risk level of 10⁻⁶, the noncarcinogen reference dose factor is more restrictive.

^dA = Sufficient human evidence for carcinogenicity.

locations (Reach 10, above Norris Reservoir; Reach 13, Poplar Creek above the confluence with East Fork Poplar Creek; and Reach 18, the Tennessee River from Ft. Loudoun Dam to the confluence with the Clinch River). It is likely that the presence of contaminants in these reference reaches are due to industrial and agricultural wastes not related to operations at the DOE Oak Ridge facilities.

4.4 POTENTIALLY LOW PRIORITY CONTAMINANTS IDENTIFIED THROUGH NONCONSERVATIVE SCREENING

For carcinogens, no reach was identified as potentially low priority (Fig. 4.1A). All reaches exceeded a nonconservative carcinogen screening index of 10^4 , indicating that potential, maximum exposures at all locations will exceed a 10^6 lifetime risk of excess cancer. For noncarcinogens, only Reach 10 qualified as a potentially low priority location (Fig. 4.1B). Nonconservative screening identified 36 substances as potentially low priority in one or more pathways at one or more reaches (Table 4.4). Among these, 13 were inorganic chemicals, 6 were organic chemicals, and 17 were radionuclides. However, contaminants designated through nonconservative screening as *potentially high priority* in one pathway at a given reach are excluded from *low priority designation* for any other pathway considered at that reach. Twelve of the substances listed through nonconservative screening as potentially low priority in Table 4.4 have also been classified as potentially high priority in Table 4.2 through conservative screening. These twelve substances are listed in Table 4.5. These contradictory results reflect the large differences between the biases of conservative versus nonconservative screening, which include the use of maximum versus average concentrations and the inclusion of additional exposure pathways resulting from possible dredging and irrigation versus casual exposure to water, fish, and sediment only. Careful data acquisition, selection, and review, as well as the justification and application of more realistic assumptions for human health risk assessments are necessary before the priority of the substances listed in Table 4.5 can be evaluated with more certainty.

4.5 CONTAMINANTS DESIGNATED AS NEITHER HIGH NOR LOW PRIORITY

Contaminants listed in Appendix B that were not identified in Appendix C or D as definitely or potentially high or low priority remain classified as contaminants of concern. These substances must be scrutinized further. Additional data and site-specific risk evaluations of reasonable maximum exposures (USEPA 1989a) may reclassify these contaminants.

In addition, eight substances detected in the off-site environment could not be classified because values were not available (Appendix A) for either oral or inhalation RfDs or for cancer slope factors (Table 4.6). The potential toxicity of these substances will have to be evaluated further before recommendations can be made about the potential importance of these substances.

The majority of the organic chemicals were not classified because they were below limits of detection (Appendix B). For example, only 19 organic compounds were quantified above the limits of detection in any sample at any reach. However, for more than 40 organic substances, the detection limits are equivalent to concentrations that would lead to

Table 4.4. Contaminants assigned a potentially low priority through nonconservative screening^a

Contaminant	Reach	Pathway	Toxicity type
Inorganic chemicals			
Chromium	1	All	Noncarcinogen
	2	Sediment and fish ingestion	(UF=500) ^b
	3	All	
	4	Sediment and fish ingestion	
	5	Sediment and fish ingestion	
	10	Sediment ingestion	
Silver	1	Fish ingestion	Noncarcinogen
	2	All	(UF=2)
	3	Sediment and fish ingestion	
	4	Sediment ingestion	
Zinc	1	All	Noncarcinogen
	2	All	(UF=10)
	3	All	
	4	All	
	5	Sediment ingestion	
	13	Water ingestion	
Nickel	1	All	Noncarcinogen
	2	Sediment ingestion	(UF=300)
	3	All	
	4	All	
	5	Sediment ingestion	
	10	Sediment ingestion	
	13	Water ingestion	
Cadmium	1	Sediment and fish	Noncarcinogen
	2	All	(UF=10)
	3	All	
	4	All	
	5	Fish ingestion	
Cyanide	1	Sediment ingestion	Noncarcinogen
	2	Water ingestion	(UF=1000)
	3	Water ingestion	
	4	Water ingestion	

Table 4.4 (continued)

Contaminant	Reach	Pathway	Toxicity type
Inorganic chemicals (continued)			
Tin	3	Water ingestion	Noncarcinogen (UF=100)
Selenium	3	Sediment and fish ingestion	Noncarcinogen (UF=15)
	2	Sediment and fish ingestion	
	4	Sediment ingestion	
	5	Sediment ingestion	
Mercury	1	Sediment ingestion	Noncarcinogen (UF=10)
	2	Sediment and water ingestion	
	3	Sediment and water ingestion	
	4	Sediment and water ingestion	
	5	Sediment ingestion	
	10	Sediment ingestion	
Vanadium	4	Sediment ingestion	Noncarcinogen (UF=100)
Barium	4	Sediment ingestion	Noncarcinogen (UF=100)
Boron	4	Sediment ingestion	Noncarcinogen (UF=100)
Uranium	1	Sediment ingestion	Noncarcinogen
	2	Sediment ingestion	
	4	Sediment ingestion	
	10	Sediment and water ingestion	
	13	Water ingestion	
Organic chemicals			
Bis(2-ethylhexyl)phthalate			
	1	Sediment ingestion	Carcinogen (B2) ^c and
	2	Sediment ingestion	Noncarcinogen
	3	Sediment ingestion	(UF=100)

Table 4.4 (continued)

Contaminant	Reach	Pathway	Toxicity type
Organic chemicals (continued)			
Methylene chloride			Carcinogen (B2) and noncarcinogen (UF=100)
	1	Sediment ingestion	
Trichlorofluoromethane		Water ingestion	Noncarcinogen
Tetrachloroethylene			Noncarcinogen
	3	Water ingestion	(UF=100)
1,1,1-Trichloroethane			Noncarcinogen
	3	Water ingestion	(UF=100)
Di-n-butyl phthalate			Noncarcinogen
	3	Sediment ingestion	(UF=100)
Radionuclides			
⁶⁰ Co	1	Sediment and fish ingestion	Carcinogen(A)
	3	Sediment ingestion	
	4	Sediment and fish ingestion	
	5	Sediment ingestion	
⁸⁹ Sr	1	Sediment ingestion	Carcinogen(A)
	2	Sediment ingestion	
	4	Sediment and fish ingestion	
	10	Sediment ingestion	
⁹⁰ Sr	1	Sediment ingestion	Carcinogen(A)
	2	Sediment ingestion	
	3	Sediment ingestion	
	4	Sediment ingestion	
	5	Sediment ingestion	
	10	Sediment ingestion	
⁹⁹ Tc	1	Fish ingestion	Carcinogen (A)
	3	Fish ingestion	
	4	Fish ingestion	

Table 4.4 (continued)

Contaminant	Reach	Pathway	Toxicity type
Radionuclides (continued)			
^{233}Pa	3	Sediment ingestion and external exposure	Carcinogen (A)
^{234}Pa	1	Sediment ingestion	Carcinogen (A)
	2	Sediment ingestion	
^{232}Th	1	Sediment/ingestion/external	Carcinogen (A)
^{234}Th	2	Sediment/ingestion/external	Carcinogen (A)
	3	Sediment ingestion	
	4	Sediment ingestion	
^{234}U	1	All except water	Carcinogen (A)
	2	Fish and water ingestion	
	4	Fish and water ingestion	
^{235}U	1	All except water sediment/external	Carcinogen (A)
	2	Sediment, fish, and water ingestion	
	3	Sediment ingestion	
	4	Water, sediment, and fish ingestion	
^{236}U	1	Water ingestion	Carcinogen (A)
	2	Water ingestion	
	4	Water ingestion	
^{238}U	1	All except sediment/external	Carcinogen (A)
	2	Fish, and water ingestion	
	4	Fish, and water ingestion	
^{239}Pu	1	Fish, sediment ingestion and external exposure	Carcinogen (A)
	2	All	
	3	Sediment ingestion and external exposure	
	4	Fish, sediment ingestion and external exposure	
	5	Sediment ingestion and external exposure	

Table 4.4 (continued)

Contaminant	Reach	Pathway	Toxicity type
Radionuclides (continued)			
²⁴¹ Am	3	Sediment ingestion and external exposure	Carcinogen (A)
	10	Sediment ingestion and external exposure	
²⁴⁴ Cm	3	Sediment ingestion and external exposure	Carcinogen (A)
	4	Sediment ingestion and external exposure	
	10	Sediment ingestion and external exposure	

^aCarcinogen screening index <10⁻⁷, noncarcinogen screening index <0.01; exposures based on average concentrations reported in fish, sediment, and water.

^bUF = uncertainty factor used by EPA to derive a RfD for noncarcinogens.

^cA = Sufficient human evidence for carcinogenicity,
B2 = Sufficient evidence in animals but none or inadequate data for humans.

Table 4.5. Contaminants within a given reach assigned both a potentially low priority through nonconservative screening and a potentially high priority using conservative screening

Contaminant	Reach
Inorganic chemicals	
Chromium	1 2 3 4 5 10
Silver	2
Zinc	1 2 3 4 5
Nickel	3 4 13
Cadmium	2 3 4
Selenium	2 3 4 5
Vanadium	4
Barium	4
Boron	4
Organic chemicals (none)	

Table 4.5 (continued)

Contaminant	Reach
Radionuclides	
Pu-239	2
Sr-90	2
Co-60	3 4 5

Table 4.6. Potential contaminants detected in either sediment, water, or fish within a given reach for which no values were obtained for either reference dose factors or cancer slope factors

Contaminant	Reach
Inorganic Chemicals	
Aluminum	2 3 4
Copper	1 2 3 4 5 13
Lead	1 2 3 4 5 10 13
Molybdenum	3
Niobium	3
Titanium	3 4
Zirconium	1 2 3 4 10
Organic Chemicals	
4-Nitrophenol	3
Radionuclides (none)	

calculated lifetime risks of cancer $\geq 10^{-6}$ when concentrations in sediment, fish, and water were set equal to the lowest reported limit of detection among all reaches (Appendix E). Of these, 30 exceeded a carcinogen screening index of 10^{-5} and 20 exceeded 10^{-4} . The detection limit for benzidine in fish exceeded a carcinogen screening index of 10^{-2} , assuming a fish consumption rate for nonconservative screening³. In many cases, it will be necessary to either document that these substances are not associated with releases from DOE/Oak Ridge operations or to develop improved analytical procedures to confirm that a given contaminant is not present at concentrations considered to be of concern.

4.6 COMPARISON OF SCREENING RESULTS USING HEALTH RISK AND ECOLOGICAL END POINTS

Screening results obtained with health risk end points are compared with ecological risk end points in Appendix F. Seven inorganic contaminants (aluminum, calcium, copper, cyanide, lead, lithium, and manganese) were identified as high-priority contaminants using ecological risk end points that were not identified as potentially high priority contaminants using health risk end points. Of these seven, only cyanide was identified as a definitely low priority contaminant by conservative screening with health risk end points (Table 4.3).

Calcium and manganese are essential elements for human health and were not included in the screening analysis using health risk end points. Aluminum, lead, and copper are known to be toxic to human health but were not listed as potentially high priority because current slope factors or RfDs were not available from EPA (IRIS 1989). However, these chemicals were identified as contaminants of concern that will require additional analyses as information becomes available. Lithium was left out of the data base that was analyzed using health risk end points, but was included in the screening analysis using ecological risk end points. Therefore, lithium will be considered a contaminant of concern and will be investigated further.

Screening analyses using health risk end points identified 3 inorganics (antimony, barium, and beryllium), 13 organic contaminants, and 11 radionuclides as potentially high priority pollutants that were not identified by screening with ecological end points (Table F1). Radionuclides were not considered in the screening analysis using ecological end points (Suter 1990) because previous studies in White Oak Lake where concentrations of radionuclides are greater than those found in the off-site environments, indicated that deleterious effects could not be detected on populations of aquatic organisms that inhabit the lake. Therefore, it was assumed that lower concentrations of radionuclides in the off-site environment should not affect populations of aquatic biota (Blaylock and Trabalka 1978).

A majority of the 13 organic contaminants that were not identified by ecological risk end points are carcinogens. Ecological screening is more concerned with effects at the population level than at the individual level; therefore, carcinogens do not receive as much consideration in ecological risk analyses as they do for human health protection.

³ This result was due to the use of an inappropriate analytical method gas chromatograph/mass spectrometry for benzidine leading to a high detection limit.

5. DISCUSSION

To the best of our knowledge, this study is the first of its kind to employ both conservative and nonconservative screening procedures. This approach has proved most useful for identifying high-priority contaminants. Nonconservative screening has tentatively identified definitely high priority contaminants in two reaches (arsenic and thallium in Reach 1 and ^{137}Cs in Reach 2) and eight other potentially high priority substances within five reaches of the off-site environment (Table 4.1). These are the contaminants that should receive the most scrutiny for further investigation and remediation considerations. Such scrutiny should include a thorough evaluation of all potential exposure pathways, the specific patterns of utilization exhibited by potentially exposed population groups, and the evidence used to derive cancer slope factors and/or noncarcinogen RfDs.

Although the end points of this document are quantitative estimates of health risk, care must be taken when interpreting these results for purposes other than those of screening. We cannot exclude the possibility, because of the conservatism adopted by EPA in deriving RfDs and cancer slope factors, that the true risk may be zero for many of the contaminants identified of concern. More detailed discussions of the strength and weaknesses of the use of RfDs for noncarcinogens and slope factors for carcinogens can be found in Jones and Owen (1989) and USEPA (1989a).

The intentional bias within conservative screening, using maximum concentrations, parameter values, and model assumptions that are designed to reduce the chance of underestimating potential exposure, and the adoption of a lower screening criterion of 10^{-6} for carcinogens and 0.1 for noncarcinogens resulted in very few substances classified as definitely low priority contaminants. Nevertheless, nonconservative screening, which used average concentrations, has shown that all reaches are likely to exhibit potential maximum exposures to carcinogens that exceed a 10^{-6} lifetime risk of excess cancer incidence (assuming that the use of EPA carcinogen slope factors is not, in and of itself, an overly conservative practice).

It should be obvious that the number of contaminants designated as low priority will be influenced by the screening criteria selected. Any justification for screening criteria less restrictive than those used in this study should decrease the number of contaminants of concern. Modification of the screening criteria used in this study should be based on guidance from regulatory authorities as to the levels of risk below which remedial action should not be required.

Some of the potentially high priority contaminants identified in this report may be artifacts due to the occurrence of false positives in sample analysis combined with the effect of compound conservatism in the use of models. Some substances designated as potentially high priority had only one measured value in the entire data base. In the case of thallium, which was designated as definitely high priority in fish of Reach 1, the average fish concentration was based on only four samples that were above the limit of detection. Two of these samples were equal to the limit of detection (1.0 mg/kg) while 22 additional samples were less than the limit of detection. Possible artifacts have been identified in the summary tables in Section 4 of this report; however, additional data will be necessary to confirm the true presence or absence of these substances.

The base-line risk assessment, which will follow this screening exercise, should include the development of site-specific pathway models and improved assumptions about pathway utilization by humans to reduce the amount of conservatism in the exposure estimate without increasing the chance of underestimating actual exposures to individuals residing in the off-site environment. An important area for further investigation is a thorough examination of the possibilities for sediment dredging and, if necessary, restricting the utilization of sediment dredged from the off-site environment.

In general, many of the contaminants identified as potentially important for human health risk considerations were also identified by Suter (1990) using environmental/ecological end points. The primary exceptions were: essential elements (calcium and manganese), which are not of concern for health risk but may affect aquatic biota; the radionuclides, which are known human carcinogens, but, at the levels present in the off-site environment, should not have a measurable ecological impact; and cyanide, which was classified as definitely low priority for human health risk, but given a potentially higher priority for environmental/ecological risk. The majority of organic substances considered potentially important for human health risk but not listed for ecological risk are chemicals classified as human carcinogens.

Investigations extending beyond this study should include an analysis of compliance with environmental regulations. The screening analysis performed in this report does not address the issues involved with regulatory compliance. Large discrepancies, however, are known to exist in risk levels associated with current environmental regulations for specific contaminants (Jones and Owen 1989). The prevalence of these discrepancies is likely to result in modifications to current environmental regulations in order for the acceptability of mixtures of contaminants in environmental media to be regulated on a consistent basis.

The results presented in this report have been produced after several iterations of calculations. These iterations have occurred because of inconsistencies in results produced by the first series of calculations. Investigation of these inconsistencies led to the identification of errors in the data base. As a consequence of this screening exercise, the quality of the present data base for contaminants measured in the off-site environment has been improved substantially.

6. CONCLUSIONS

This report demonstrates the utility of using both conservatively biased and nonconservative approaches for screening of large data sets. Screening of these data is necessary to determine sampling priorities and to focus the efforts of the base-line risk analysis. The data base used for screening included approximately 9,000 values for contaminants in sediment, 9,000 for fish, and 25,000 for water. Many of these were organic chemicals that were below the limits of detection. Of those contaminants that were detected, conservative screening was not successful in identifying many as having a definitely low priority for further analysis.

Nonconservative screening tentatively identified three contaminants, arsenic in the water of McCoy Branch at Reach 1, thallium in fish at Reach 1, and ¹³⁷Cs in the sediment of the embayment of White Oak Creek downstream from White Oak Lake, as definitely high priority substances requiring further analysis and possible consideration for remediation. The locations where these samples were taken are within the boundaries of the DOE/ORR. In addition, the presence of thallium may be an analytical artifact. Nonconservative screening also identified arsenic, thallium, uranium, PCB 1254 and 1260, chlordane, ⁶⁰Co and ²³⁴Pa as potentially high priority contaminants in at least one or more locations (primarily Reaches 1 through 5). The presence of arsenic, thallium, and chlordane may be the consequence of industrial and agricultural operations other than DOE/Oak Ridge Operations. No reach was identified as low priority, or even potentially low priority, given a screening criterion of 10^6 for carcinogens.

This screening analysis has used criteria that are entirely risk-based. Screening indices for carcinogens have been calculated using EPA-approved or -proposed slope factors for inorganic and organic chemicals and a revised dose-to-risk conversion factor for radionuclides. Noncarcinogen screening indices have been based on the use of EPA-approved or -proposed RfDs. Despite the application of these screening indices, this report should not be construed as a human health risk assessment.

The conservative approach used for this screening analysis is more restrictive and the nonconservative approach is less restrictive than the approach that is typically taken to estimate reasonable maximum exposures to potential human receptors (USEPA 1989a). The intent of this study was to perform an initial scoping exercise, based on existing data, to identify contaminants of possible concern prior to undertaking a detailed sampling and analysis effort to acquire additional data for a base-line assessment of human health risk. In addition, because of large uncertainty in the application of slope factors and RfDs at low concentrations, one cannot exclude the possibility that the true risk to individuals in the off-site environment is actually zero.

Further data and more refined analysis of current data using more realistic, site-specific assumptions should result in a different classification of many of the contaminants of concern identified in this report; however, it is unlikely that potential maximum exposures estimated from nonconservative screening have been grossly overstated unless humans are actively prevented from utilizing the media in which contaminants have been sampled.

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Appendix A

REFERENCE DOSE FACTORS AND SLOPE (CANCER POTENCY) FACTORS FOR ORGANIC AND INORGANIC CHEMICALS AND RADIONUCLIDES



Table A1. Reference dose factors and slope (cancer potency) factors for inorganic compounds^a

Inorganic compound	Oral reference dose factors (mg/kg/day)	Inhalation reference dose factors (mg/kg/day)	Oral slope factors 1/(mg/kg/day)	Inhalation slope factors 1/(mg/kg/day)
ALUMINUM				
ANTIMONY	4.00E-04			
ARSENIC	1.00E-03 ^b	Withdrawn	1.75E+00 ^b	5.01E+01
BARIUM	5.00E-02			
BERYLLIUM	5.00E-03		4.30E+00	8.40E+00
BORON	9.00E-02			
CADMIUM	1.00E-03			6.10E+00
CHROMIUM VI	5.00E-03			4.10E+01
COPPER	No information			
CYANIDE	2.00E-02			
LEAD	Under review			
MERCURY	3.00E-04 ^b			
MOLYBDENUM				
NICKEL ^c	2.00E-02			1.19E+00
NIOBIUM				
SELENIUM	3.00E-03	1.00E-03		
SILVER	3.00E-03			
THALLIUM ^c	7.00E-05 ^b			
TIN	6.00E-01 ^b			
TITANIUM				
URANIUM ^c	3.00E-03		5.60E-06	
VANADIUM	7.00E-03 ^b			
ZINC	2.00E-01 ^b			
ZIRCONIUM	No information			

All entries from IRIS unless otherwise footnoted.

^a IRIS 1989. Integrated Risk Information System (data base), U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C., December.

^b USEPA 1989c. (U.S. Environmental Protection Agency). 1989c. *Health Effects Assessment Summary Tables, Fourth Quarter, FY 1989*. OERR 9200.6-303-(89-3). EPA Office of Water Regulations and Standards, Washington, D.C.

^c Soluble salts.

Table A2. Reference dose factors and slope (cancer potency) factors for organic chemicals^a

Organic Compound	Oral reference dose factors (mg/kg/day)	Inhalation reference dose factors (mg/kg/day)	Oral slope factors 1/(mg/kg/day)	Inhalation slope factors 1/(mg/kg/day)
1,1,1-TRICHLOROETHANE	9.00E-02			
1,1,2,2-TETRACHLOROETHANE			2.00E-01	
1,1,2-TRICHLOROETHANE	4.00E-03		5.70E-02	
1,1-DICHLOROETHANE	1.00E-01 ^b		9.10E-02 ^b	
1,1-DICHLOROETHYLENE	9.00E-03		6.00E-01	
1,2,4-TRICHLOROBENZENE	2.00E-02 ^b			
1,2,5,6-DIBENZANTHACENE			1.15E+01 ^c	
1,2-DICHLOROBENZENE	9.00E-02			
1,2-DICHLOROETHANE			9.10E-02	
1,2-DICHLOROPROPANE			6.80E-02 ^b	
1,2-DIPHENYLHYDRAZINE			8.00E-01	
1,3-DICHLOROBENZENE				
1,3-DICHLOROPROPENE	3.00E-04		1.80E-01 ^b	
1,4-DICHLOROBENZENE			2.40E-02 ^b	
2,4,6-TRICHLOROPHENOL			2.00E-02 ^b	
2,4-DICHLOROPHENOL	3.00E-03			
2,4-DIMETHYLPHENOL				
2,4-DINITROPHENOL	2.00E-03			
2,4-DINITROTOLUENE			6.80E-01 ^b	
2,6-DINITROTOLUENE			6.80E-01 ^b	
2-CHLOROETHYL VINYL ETHER				
2-CHLORONAPHTHALENE				
2-CHLOROPHENOL	5.00E-03			
2-NITROPHENOL				
3,3'-DICHLOROBENZIDINE			4.50E-01	
4,6-DINITRO-ORTHO-CRESOL	1.00E-04 ^b			
4-BROMOPHENYL PHENYL ETHER				
4-CHLOROPHENYL PHENYL ETHER				
4-NITROPHENOL				
ACENAPHTHENE			1.15E+01 ^c	
ACENAPHTHYLENE			1.15E+01 ^c	
ACROLEIN	1.60E-02			
ACRYLONITRILE			5.40E-01	
ALDRIN	3.00E-05		1.70E+01	
ALPHA BHC			6.30E+00	
ANTHRACENE			1.15E+01 ^c	
BENZENE			2.90E-02	

Table A2 (continued)

Organic Compound	Oral reference dose factors (mg/kg/day)	Inhalation reference dose factors (mg/kg/day)	Oral slope factors 1/(mg/kg/day)	Inhalation slope factors 1/(mg/kg/day)
BENZIDINE	3.00E-03		2.30E+02	
BENZO(A)ANTHRACENE			1.15E+01 ^c	
BENZO(B)FLUORANTHENE			1.15E+01 ^c	
BENZO(GHI)PERYLENE			1.15E+01 ^c	
BENZO(K) FLUORANTHENE			1.15E+01 ^c	
BENZO-A-PYRENE			1.15E+01 ^c	
BETA BHC			1.80E+00	
BIS (2-CHLOROETHOXY) METHANE				
BIS (2-CHLOROETHYL) ETHER			1.10E+00	
BIS (2-CHLOROISOPROPYL) ETHER	4.00E-02			
BIS (2-ETHYLHEXYL) PHTHALATE	2.00E-02		1.40E-02	
BIS (CHLOROMETHYL) ETHER			2.20E+02	
BROMOFORM	2.00E-02		7.90E-03	
BUTYLBENZYLPHthalate	2.00E-01			
CARBON TETRACHLORIDE	7.00E-04		1.30E-01	
CHLORDANE	6.00E-05		1.30E+00	
CHLOROBENZENE	2.00E-02			
CHLORODIBROMOMETHANE	2.00E-02		8.40E-02 ^b	
CHLOROETHANE				
CHLOROFORM	1.00E-02		6.10E-03	
CHRYSENE			1.15E+01 ^c	
CIS-1 3-DICHLOROPROPENE	3.00E-04			
DELTA BHC				
DI-N-BUTYL PHTHALATE	1.00E-01			
DI-N-OCTYL PHTHALATE				
DIBENZ(A H)ANTHRACENE			1.15E+01 ^c	
DICHLOROBROMOMETHANE	2.00E-02 ^b		1.30E-01 ^b	
DICHLORODIFLUOROMETHANE	2.00E-01			
DIELDRIN	5.00E-05		1.60E+01	
DIETHYL PHTHALATE	8.00E-01			
DIMETHYL PHTHALATE				
ENDOSULFAN SULFATE				
ENDOSULFAN, ALPHA	5.00E-05			
ENDOSULFAN, BETA	5.00E-05			
ENDRIN	3.00E-04			
ENDRIN ALDEHYDE				
ETHYLBENZENE	1.00E-01			
FLUORANTHENE			1.15E+01 ^c	

Table A2 (continued)

Organic Compound	Oral reference dose factors (mg/kg/day)	Inhalation reference dose factors (mg/kg/day)	Oral slope factors 1/(mg/kg/day)	Inhalation slope factors 1/(mg/kg/day)
FLUORENE			1.15E+01 ^c	
GAMMA-BHC(LINDANE)			1.30E+00 ^b	
HEPTACHLOR	5.00E-04		4.50E+00	
HEPTACHLOR EPOXIDE	1.30E-05		9.10E+00	
HEXACHLOROBENZENE	8.00E-04		1.70E+00 ^b	
HEXACHLOROBUTADIENE	2.00E-03		7.80E-02	
HEXACHLOROCYCLOPENTADIENE	7.00E-03			
HEXACHLOROETHANE	1.00E-03		1.40E-02	
INDENO (1,2,3-CD) PYRENE			1.15E+01 ^c	
ISOPHORONE	2.00E-01		4.13E-03 ^b	
METHYL BROMIDE	1.40E-03 ^b			
METHYL CHLORIDE			1.30E-02 ^b	
METHYLENE CHLORIDE	6.00E-02		7.50E-03	
N-BUTYL BENZYL PHTHALATE	2.00E-01			
N-NITROSODI-N-PROPYLAMINE			7.00E+00	
N-NITROSODIMETHYLAMINE			5.10E+01	
N-NITROSODIPHENYLAMINE			4.90E-03	
NAPHTHALENE	4.00E-01 ^b			
NITROBENZENE	5.00E-04			
P,P'DDD			2.40E-01	
P,P'DDE			3.40E-01	
P,P'DDT	5.00E-04		3.40E-01 ^b	
PARACHLOROMETA CRESOL				
PCB-1254 (AROCLOR 1254)*			7.70E+00	
PCB-1260 (AROCLOR 1260)*			7.70E+00	
PENTACHLOROPHENOL	3.00E-02			
PHENANTHRENE			1.15E+01 ^c	
PHENOL	6.00E-01			
PYRENE			1.15E+01 ^c	
TETRACHLOROETHYLENE	1.00E-02		5.10E-02 ^b	
TOLUENE	3.00E-01			
TOXAPHENE			1.10E+00	
TRANS-1 3-DICHLOROPROPENE	3.00E-04		1.80E-01 ^b	
TRANS-1,2-DICHLOROETHENE	2.00E-02			
TRICHLOROETHYLENE			1.10E-02 ^b	
TRICHLOROFLUOROMETHANE	3.00E-01			
VINYL CHLORIDE			2.30E+00	

Table A2 (continued)

All entries from IRIS unless otherwise footnoted.

a IRIS 1989. Integrated Risk Information System (data base), U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C., December.

b USEPA. (U.S. Environmental Protection Agency). 1989c. *Health Effects Assessment Summary Tables, Fourth Quarter, FY 1989*. OERR 9200.6-303-(89-3). EPA Office of Water Regulations and Standards, Washington, D.C.

c USEPA (U.S. Environmental Protection Agency). 1986. *Quality Criteria for Water, May 1, 1987 update*. EPA 440/5-86-001. EPA Office of Water Regulations and Standards, Washington, D.C.

Table A3. Dose conversion factors for radionuclides^{a b}

Radionuclide	Ingestion (Sv/Bq)	Inhalation (Sv/Bq)	External (Sv/d)/(Bq/m ²)
Am-241	5.94E-07	1.43E-04	2.26E-12
Cm-244	3.13E-07	7.61E-05	6.63E-14
Co-60	7.28E-09	5.91E-08	1.71E-10
Cs-134	1.98E-08	1.25E-08	1.19E-10
Cs-137	1.35E-08	8.63E-09	4.41E-11
Eu-152	1.75E-09	5.97E-08	8.41E-11
Eu-154	2.58E-09	7.73E-08	9.17E-11
H-3	1.70E-11	1.70E-11	
Np-237	1.07E-05	1.35E-04	2.45E-12
Pa-233	9.81E-10	2.58E-09	1.77E-11
Pa-234	5.84E-10	2.20E-10	1.48E-10
Pu-238	1.07E-07	1.25E-04	6.87E-14
Pu-239	1.19E-07	1.40E-04	3.01E-14
Sr-89	2.50E-09	1.12E-08	4.38E-12
Sr-90	3.85E-08	3.51E-07	
Tc-99	3.95E-10	2.25E-09	4.68E-17
Th-232	7.38E-07	4.43E-04	5.28E-14
Th-234	3.69E-09	9.47E-09	7.58E-13
U-234	7.66E-08	3.58E-05	1.35E-13
U-235	7.19E-08	3.32E-05	1.44E-11
U-236	7.26E-08	3.39E-05	5.86E-14
U-238	6.88E-08	3.20E-05	8.12E-12

^a Dose factors are effective dose equivalents and include the contribution of daughter products.

^b Dose conversion factors developed for NCRP for screening purposes by K. F. Eckerman of ORNL (see footnote 1 Section 2.1).

Appendix B

**MAXIMUM AND MEAN CONCENTRATIONS OF ORGANIC AND INORGANIC
CHEMICALS AND RADIONUCLIDES IN SEDIMENT, FISH,
AND WATER FOR EACH STREAM REACH**

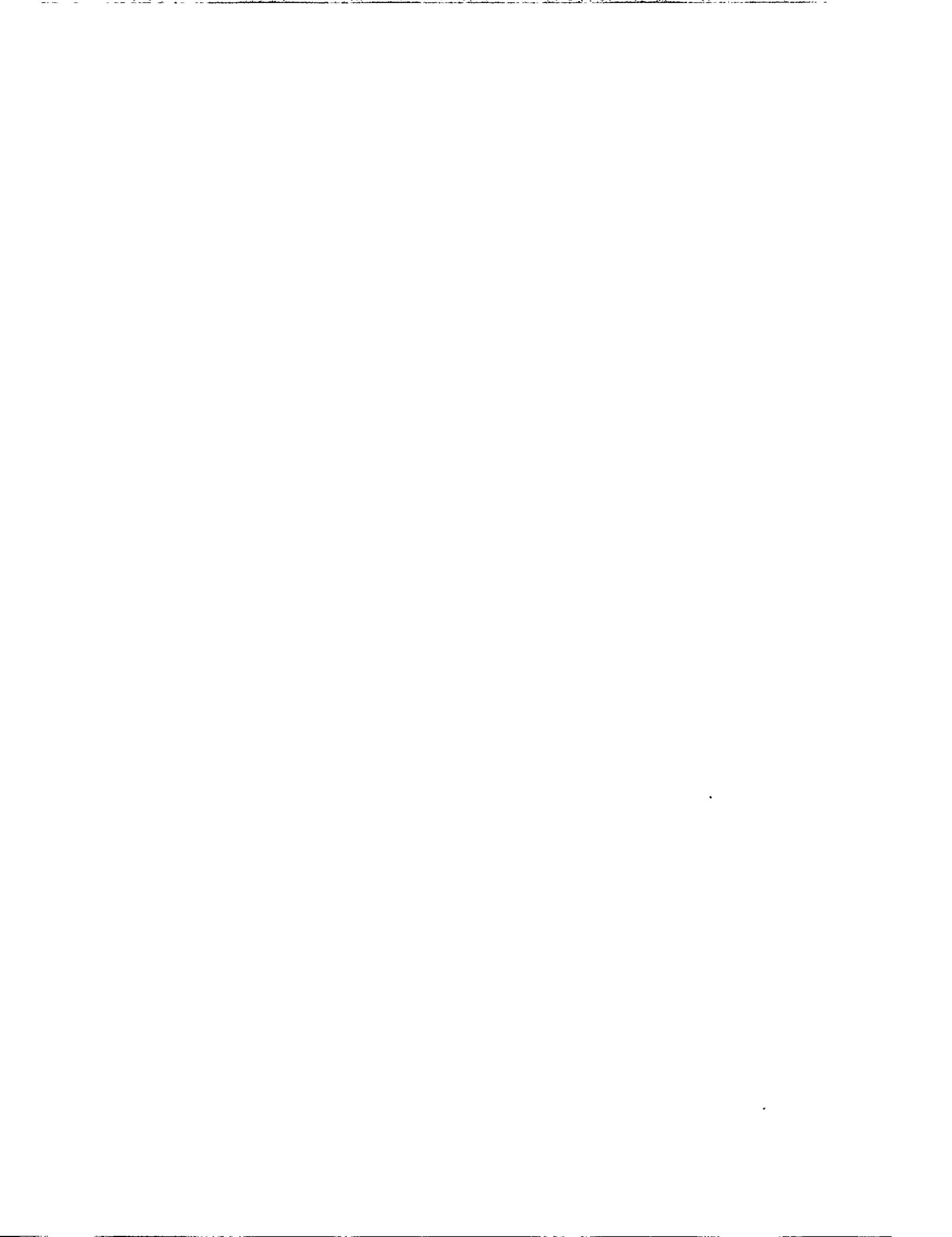


Table B1. Maximum concentrations of inorganic compounds in sediment, fish, and water

Reach	Inorganic Compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
1	ANTIMONY	3.00E-01	1.00E+00	
1	ARSENIC	1.70E+01	4.20E-01	3.60E-01
1	BERYLLIUM	1.60E+00	0.06	
1	CADMIUM	5.00E-01	1.40E-01	< 6.00E-03
1	CHROMIUM	2.70E+01	3.60E-01	2.10E-02
1	COPPER	5.40E+01	1.80E+00	5.70E-02
1	CYANIDE	4.00E-01		
1	LEAD	4.60E+01	1.60E+00	< 2.00E-02
1	MERCURY, TOTAL	1.00E-01	4.40E-01	5.20E-03
1	NICKEL	3.60E+01	1.00E+00	2.00E-02
1	SELENIUM	2.00E+00	1.80E+00	3.20E-02
1	SILVER	< 1.00E+00	7.00E-01	
1	THALLIUM	< 5.00E+00	3.80E+00	
1	URANIUM	5.90E+00		
1	ZINC	1.50E+02	1.10E+01	2.80E-02
1	ZIRCONIUM	2.30E+02		< 2.00E-03
2	ALUMINUM	1.00E+04		1.70E+01
2	ANTIMONY		1.00E+00	
2	ARSENIC	1.20E+01	4.00E-01	9.00E-01
2	BERYLLIUM		4.00E-02	
2	CADMIUM	4.20E+00	4.00E-02	3.00E-03
2	CHROMIUM	2.90E+02	3.60E-01	9.30E-02
2	COPPER	1.70E+01	1.00E+01	1.30E-01
2	CYANIDE	< 1.00E+00		2.60E-02
2	LEAD	5.10E+01	5.00E-01	1.90E-02
2	MERCURY, TOTAL	A 6.00E+00	5.60E-01	4.00E-04
2	NICKEL	3.00E+01	1.00E+00	7.70E-02
2	SELENIUM	1.10E+02	4.10E-01	
2	SILVER	1.00E+01	5.00E-01	< 5.00E-03
2	THALLIUM		1.00E+00	
2	URANIUM	1.80E+01		
2	ZINC	9.20E+01	1.10E+01	1.80E-01
2	ZIRCONIUM	8.90E+02		
3	ALUMINUM	1.40E+05		1.20E+01
3	ANTIMONY		1.00E+00	2.70E-01
3	ARSENIC	6.80E+01	6.00E-01	2.10E-02
3	BARIUM			< 1.00E-01
3	BERYLLIUM		4.0E-02	2.40E-03
3	BORON			1.20E+01
3	CADMIUM	3.50E+00	2.00E-02	5.00E-02

Table B1 (continued)

Reach	Inorganic Compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
3	CHROMIUM	2.70E+02	5.90E-01	4.10E-02
3	COPPER	2.60E+02	4.10E+00	4.10E-01
3	CYANIDE	< 1.10E+00		1.98E-01
3	LEAD	9.40E+01	3.60E-01	2.10E-01
3	MERCURY, TOTAL	5.90E+00	1.70E+00	1.00E-03
3	MOLYBDENUM			4.00E-02
3	NICKEL	1.30E+03	2.00E+00	1.60E+00
3	NIOBIUM			3.00E-02
3	SELENIUM	1.60E+02	5.00E-01	< 5.00E-02
3	SILVER	2.00E+00	6.00E-01	2.60E-02
3	THALLIUM		1.00E+00	
3	TIN			3.00E-02
3	TITANIUM			5.40E-02
3	URANIUM	1.79E+02		4.94E+00
3	VANADIUM			< 5.00E-01
3	ZINC	3.70E+02	1.60E+01	1.00E+00
3	ZIRCONIUM	4.70E+02		2.80E-02
4	ALUMINUM	8.15E+04		
4	ANTIMONY		< 1.00E+00	
4	ARSENIC	1.10E+01	4.00E-01	5.40E-03
4	BARIUM	4.71E+02		
4	BERYLLIUM	2.68E+00	< 1.00E-01	
4	BORON	3.10E+02		
4	CADMİUM	1.60E+00	2.00E-02	3.00E-03
4	CHROMIUM	9.04E+01	8.20E-01	7.70E-02
4	COPPER	6.57E+01	5.60E-01	3.00E-02
4	CYANIDE	< 8.00E-01		
4	LEAD	1.30E+02	4.50E-01	2.50E-02
4	MERCURY, TOTAL	4.70E+01	1.20E+00	6.00E-04
4	NICKEL	5.80E+01	1.00E+00	7.40E-02
4	SELENIUM	1.90E+02	2.60E+00	
4	SILVER	3.70E+00	< 2.00E-01	
4	THALLIUM		< 1.0E+00	
4	TITANIUM	4.08E+03		
4	URANIUM	7.82E+00		
4	VANADIUM	9.90E+01		
4	ZINC	1.68E+02	1.70E+01	2.40E-01
4	ZIRCONIUM	6.10E+02		
5	ARSENIC	1.60E+01	2.00E-01	
5	BERYLLIUM	1.60E+00		
5	CADMİUM	< 1.00E+00	5.00E-02	

Table B1 (continued)

Reach	Inorganic Compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
5	CHROMIUM	5.40E+01	9.80E-01	
5	COPPER	4.00E+01		< 1.00E-02
5	LEAD	5.30E+01		
5	MERCURY, TOTAL	2.44E+01	1.80E-01	
5	NICKEL	2.40E+01	< 1.00E+00	
5	SELENIUM	8.00E-01		
5	SILVER	< 1.00E+00	< 2.00E-01	
5	ZINC	2.20E+02		< 1.00E-02
10	ARSENIC	2.40E+01		
10	CADMUM	< 5.00E-01		
10	CHROMIUM	2.30E+01		
10	CYANIDE	< 9.00E-01		
10	LEAD	6.70E+01		
10	MERCURY, TOTAL	1.00E-01		
10	NICKEL	2.70E+01		
10	SILVER	< 1.00E+00		
10	URANIUM	4.30E+00		
10	ZIRCONIUM	2.10E+02		
13	ARSENIC			1.40E-02
13	CADMUM			< 2.00E-03
13	CHROMIUM			< 1.00E-02
13	COPPER			1.50E-02
13	CYANIDE			3.00E-02
13	LEAD			1.80E-02
13	MERCURY			< 2.00E-04
13	NICKEL			7.60E-02
13	ZINC			1.00E-01
18	ARSENIC		3.00E-01	
18	CADMUM		1.00E-02	
18	CHROMIUM		9.00E-01	
18	MERCURY		4.50E-01	
18	NICKEL		< 1.00E+00	
18	SILVER		< 2.00E-01	

A= duplicate samples averaged.

< = below the limit of detection.

Table B2. Maximum concentrations of organic chemicals
in sediment, fish, and water

Reach	Inorganic Compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
1	1,1,1-TRICHLOROETHANE	< 8.00E-03	< 5.00E-02	
1	1,1,2,2-TETRACHLOROETHANE	< 8.00E-03	< 5.00E-02	
1	1,1,2-TRICHLOROETHANE	< 8.00E-03	< 5.00E-02	
1	1,1-DICHLOROETHANE	< 8.00E-03	< 5.00E-02	
1	1,1-DICHLOROETHYLENE	< 8.00E-03	< 5.00E-02	
1	1,2,4-TRICHLOROBENZENE	< 2.00E+00	< 3.30E+00	
1	1,2,5,6-DIBENZANTHACENE	< 2.00E+00	< 3.30E+00	
1	1,2-DICHLOROBENZENE	< 2.00E+00	< 3.30E+00	
1	1,2-DICHLOROETHANE	< 8.00E-03	< 5.00E-02	
1	1,2-DICHLOROPROPANE	< 8.00E-03	< 5.00E-02	
1	1,2-DIPHENYLHYDRAZINE	< 2.00E+00	< 3.30E+00	
1	1,3-DICHLOROBENZENE	< 2.00E+00	< 3.30E+00	
1	1,3-DICHLOROPROPENE	< 8.00E-03	< 5.00E-02	
1	1,4-DICHLOROBENZENE	< 2.00E+00	< 3.30E+00	
1	2,4,6-TRICHLOROPHENOL	< 5.00E-01	< 3.30E+00	
1	2,4-DICHLOROPHENOL	< 5.00E-01	< 3.30E+00	
1	2,4-DIMETHYLPHENOL	< 5.00E-01	< 3.30E+00	
1	2,4-DINITROPHENOL	< 5.00E+00	< 3.30E+01	
1	2,4-DINITROTOLUENE	< 2.00E+00	< 3.30E+00	
1	2,6-DINITROTOLUENE	< 2.00E+00	< 3.30E+00	
1	2-CHLOROETHYL VINYL ETHER	< 8.00E-03	< 5.00E-02	
1	2-CHLORONAPHTHALENE	< 2.00E+00	< 3.30E+00	
1	2-CHLOROPHENOL	< 5.00E-01	< 3.30E+00	
1	2-NITROPHENOL	< 5.00E-01	< 3.30E+00	
1	3,3'-DICHLOROBENZIDINE	< 5.00E+00	< 8.20E+00	
1	4,6-DINITRO-ORTHO-CRESOL	< 2.50E+00	< 1.60E+01	
1	4-BROMOPHENYL PHENYL ETHER	< 2.00E+00	< 3.30E+00	
1	4-CHLOROPHENYL PHENYL ETHER	< 2.00E+00	< 3.30E+00	
1	4-NITROPHENOL	< 5.00E-01	< 3.30E+00	
1	ACENAPHTHENE	< 2.00E+00	< 3.30E+00	
1	ACENAPHTHYLENE	< 2.00E+00	< 3.30E+00	
1	ACROLEIN	< 8.00E-02	< 5.00E-02	
1	ACRYLONITRILE	< 8.00E-02	< 5.00E-02	
1	ALDRIN	< 5.00E-01	< 1.00E-02	
1	ALPHA BHC	< 5.00E-01	< 1.00E-02	
1	ANTHRACENE	< 2.00E+00	< 3.30E+00	
1	BENZENE	< 8.00E-03	< 5.00E-02	
1	BENZIDINE	<** 1.00E+01	< 1.60E+01	
1	BENZO(A)ANTHRACENE	< 2.00E+00	< 3.30E+00	
1	BENZO(B)FLUORANTHENE	< 2.00E+00	< 3.30E+00	
1	BENZO(GH)PERYLENE	< 2.00E+00	< 3.30E+00	
1	BENZO(KQ)FLUOR ANTHENE	< 2.00E+00	< 3.30E+00	
1	BENZO-A-PYRENE	< 2.00E+00	< 3.30E+00	

Table B2 (continued)

Reach	Inorganic Compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
1	BETA BHC	< 5.00E-01	< 1.00E-02	
1	BIS (2-CHLOROETHOXY) METHANE	< 2.00E+00	< 3.30E+00	
1	BIS (2-CHLOROETHYL) ETHER	< 2.00E+00	< 3.30E+00	
1	BIS (2-CHLOROISOPROPYL) ETHER	< 2.00E+00	< 3.30E+00	
1	BIS (2-ETHYLHEXYL) PHTHALATE	2.20E+00	< 3.30E+00	
1	BIS (CHLOROMETHYL) ETHER	< 8.00E-03	< 5.00E-02	
1	BROMOFORM	< 8.00E-03	< 5.00E-02	
1	CARBON TETRACHLORIDE	< 8.00E-03	< 5.00E-02	
1	CHLORDANE	< 2.50E+00	1.60E-01	
1	CHLOROBENZENE	< 8.00E-03	< 5.00E-02	
1	CHLORODIBROMOMETHANE	< 8.00E-03	< 5.00E-02	
1	CHLOROETHANE	< 8.00E-03	< 5.00E-02	
1	CHLOROFORM	< 8.00E-03	< 5.00E-02	
1	CHRYSENE	< 2.00E+00	< 3.30E+00	
1	DELTA BHC	< 5.00E-01	< 1.00E-02	
1	DI-N-BUTYL PHTHALATE	< 2.00E+00	< 3.30E+00	
1	DI-N-OCTYL PHTHALATE	< 2.00E+00	< 3.30E+00	
1	DICHLOROBROMOMETHANE	< 8.00E-03	< 5.00E-02	
1	DICHLORODIFLUOROMETHANE	< 8.00E-03	< 5.00E-02	
1	DIELDRIN	< 5.00E-01	< 1.00E-02	
1	DIETHYL PHTHALATE	< 2.50E+00	< 3.30E+00	
1	DIMETHYL PHTHALATE	< 2.00E+00	< 3.30E+00	
1	ENDOSULFAN SULFATE	< 5.00E-01	< 1.00E-02	
1	ENDOSULFAN, ALPHA	< 5.00E-01	< 1.00E-02	
1	ENDOSULFAN, BETA	< 5.00E-01	< 1.00E-02	
1	ENDRIN	< 5.00E-01	< 1.00E-02	
1	ENDRIN ALDEHYDE	< 5.00E-01	< 1.00E-02	
1	ETHYLBENZENE	< 8.00E-03	< 5.00E-02	
1	FLUORANTHENE	5.90E-01	< 3.30E+00	
1	FLUORENE	< 2.00E+00	< 3.30E+00	
1	GAMMA-BHC(LINDANE)	< 5.00E-01	< 1.00E-02	
1	HEPTACHLOR	< 5.00E-01	< 1.00E-02	
1	HEPTACHLOR EPOXIDE	< 5.00E-01	< 1.00E-02	
1	HEXACHLOROBENZENE	< 2.00E+00	< 3.30E+00	
1	HEXACHLOROBUTADIENE	< 2.00E+00	< 3.30E+00	
1	HEXACHLOROCYCLOPENTADIENE	< 2.00E+00	< 3.30E+00	
1	HEXACHLOROETHANE	< 2.00E+00	< 3.30E+00	
1	INDENO (1,2,3-CD) PYRENE	< 2.00E+00	< 3.30E+00	
1	ISOPHORONE	< 2.00E+00	< 3.30E+00	
1	METHYL BROMIDE	< 8.00E-03	< 5.00E-02	
1	METHYL CHLORIDE	< 8.00E-03	< 5.00E-02	
1	METHYLENE CHLORIDE	1.00E-01	< 2.50E-01	
1	N-BUTYL BENZYL PHTHALATE	< 2.00E+00	< 3.30E+00	
1	N-NITROSODI-N-PROPYLAMINE	< 2.00E+00	< 3.30E+00	
1	N-NITROSODIMETHYLAMINE	< 2.00E+00	< 3.30E+00	

Table B2 (continued)

Reach	Inorganic Compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
1	N-NITROSODIPHENYLAMINE	< 2.00E+00	< 3.30E+00	
1	NAPHTHALENE	< 2.00E+00	< 3.30E+00	
1	NITROBENZENE	< 2.00E+00	< 3.30E+00	
1	P,P'DDD	< 5.00E-01	1.00E-01	
1	P,P'DDE	< 5.00E-01	< 1.00E-02	
1	P,P'DDT	< 5.00E-01	1.60E-01	
1	PARACHLOROMETA CRESOL	< 5.00E-01	< 3.30E+00	
1	PCB-1254 (AROCLOR 1254)	< 5.00E+00	1.40E+00	
1	PCB-1260 (AROCLOR 1260)	< 5.00E+00	3.40E+00	
1	PENTACHLOROPHENOL	< 5.00E-01	< 3.30E+00	
1	PHENANTHRENE	< 2.00E+00	< 3.30E+00	
1	PHENOL	< 5.00E-01	< 3.30E+00	
1	PYRENE	< 2.00E+00	< 3.30E+00	
1	TETRACHLOROETHYLENE		< 5.00E-02	
1	TOLUENE	< 8.00E-03	< 5.00E-02	
1	TOXAPHENE	< 5.00E+00	< 5.00E-01	
1	TRANS-1,2-DICHLOROETHENE	< 8.00E-03	< 5.00E-02	
1	TRICHLOROETHYLENE		< 5.00E-02	
1	TRICHLOROFLUOROMETHANE	< 8.00E-03	< 5.00E-02	
1	VINYL CHLORIDE	< 8.00E-03	< 5.00E-02	
2	1,1,1-TRICHLOROETHANE		< 5.00E-02	
2	1,1,2,2-TETRACHLOROETHANE		< 5.00E-02	
2	1,1,2-TRICHLOROETHANE		< 5.00E-02	
2	1,1-DICHLOROETHANE		< 5.00E-02	
2	1,1-DICHLOROETHYLENE		< 5.00E-02	
2	1,2,4-TRICHLOROBENZENE	< 1.40E+00	< 6.70E-01	
2	1,2,5,6-DIBENZANTHRACENE	< 1.40E+00	< 6.70E-01	
2	1,2-DICHLOROBENZENE	< 1.40E+00	< 6.70E-01	
2	1,2-DICHLOROETHANE		< 5.00E-02	
2	1,2-DICHLOROPROPANE		< 5.00E-02	
2	1,2-DIPHENYLHYDRAZINE	< 1.40E+00	< 6.70E-01	
2	1,3-DICHLOROBENZENE	< 1.40E+00	< 6.70E-01	
2	1,3-DICHLOROPROPENE		< 5.00E-02	
2	1,4-DICHLOROBENZENE	< 1.40E+00	< 6.70E-01	
2	2,4,6-TRICHLOROPHENOL		< 6.70E-01	
2	2,4-DICHLOROPHENOL		< 6.70E-01	
2	2,4-DIMETHYLPHENOL		< 6.70E-01	
2	2,4-DINITROPHENOL		< 6.70E+00	
2	2,4-DINITROTOLUENE	< 1.40E+00	< 6.70E-01	
2	2,6-DINITROTOLUENE	< 1.40E+00	< 6.70E-01	
2	2-CHLOROETHYL VINYL ETHER		< 5.00E-02	
2	2-CHLORONAPHTHALENE	< 1.40E+00	< 6.70E-01	
2	2-CHLOROPHENOL		< 6.70E-01	
2	2-NITROPHENOL		< 6.70E-01	
2	3,3'-DICHLOROBENZIDINE	< 3.50E+00	< 1.70E+00	

Table B2 (continued)

Reach	Inorganic Compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
2	4-BROMOPHENYL PHENYL ETHER	< 1.40E+00	< 6.70E-01	
2	4-CHLOROPHENYL PHENYL ETHER	< 1.40E+00	< 6.70E-01	
2	ACENAPHTHENE	< 1.40E+00	< 6.70E-01	
2	ACENAPHTHYLENE	< 1.40E+00	< 6.70E-01	
2	ACROLEIN		< 5.00E-02	
2	ACRYLONITRILE		< 5.00E-02	
2	ALDRIN		< 1.00E-02	
2	ALPHA BHC		< 1.00E-02	
2	ANTHRACENE	< 1.40E+00	< 6.70E-01	
2	BENZENE		< 5.00E-02	
2	BENZIDINE	<** 7.00E+00	< 3.40E+00	
2	BENZO(A)ANTHRACENE	< 1.40E+00	< 6.70E-01	
2	BENZO(B)FLUORANTHENE	< 1.40E+00	< 6.70E-01	
2	BENZO(GH)PERYLENE	< 1.40E+00	< 6.70E-01	
2	BENZO(K)FLUORANTHENE	< 1.40E+00	< 6.70E-01	
2	BENZO-A-PYRENE	< 1.40E+00	< 6.70E-01	
2	BETA BHC		< 1.00E-02	
2	BIS (2-CHLOROETHOXY) METHANE	< 1.40E+00	< 6.70E-01	
2	BIS (2-CHLOROETHYL) ETHER	< 1.40E+00	< 6.70E-01	
2	BIS (2-CHLOROISOPROPYL) ETHER	< 1.40E+00	< 6.70E-01	
2	BIS (2-ETHYLHEXYL) PHTHALATE	1.90E+00	< 6.70E-01	
2	BIS (CHLOROMETHYL) ETHER		< 5.00E-02	
2	BROMOFORM		< 5.00E-02	< 5.00E-03
2	CARBON TETRACHLORIDE		< 5.00E-02	
2	CHLORDANE		2.50E-01	
2	CHLOROBENZENE		< 5.00E-02	
2	CHLORODIBROMOMETHANE		< 5.00E-02	
2	CHLOROETHANE		< 5.00E-02	
2	CHLOROFORM		< 5.00E-02	< 5.00E-03
2	CHRYSENE	< 1.40E+00	< 6.70E-01	
2	DELTA BHC		< 1.00E-02	
2	DI-N-BUTYL PHTHALATE	< 1.40E+00	< 6.70E-01	
2	DI-N-OCTYL PHTHALATE	< 1.40E+00	< 6.70E-01	
2	DICHLOROBROMOMETHANE		< 5.00E-02	
2	DICHLORODIFLUOROMETHANE		< 5.00E-02	
2	DIELDRIN		< 1.00E-02	
2	DIETHYL PHTHALATE	< 1.40E+00	< 6.70E-01	
2	DIMETHYL PHTHALATE	< 1.40E+00	< 6.70E-01	
2	ENDOSULFAN SULFATE		< 1.00E-02	
2	ENDOSULFAN, ALPHA		< 1.00E-02	
2	ENDOSULFAN, BETA		< 1.00E-02	
2	ENDRIN		< 1.00E-02	
2	ENDRIN ALDEHYDE		< 1.00E-02	
2	ETHYLBENZENE		< 5.00E-02	

Table B2 (continued)

Reach	Inorganic Compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
2	FLUORANTHENE	< 1.40E+00	< 6.70E-01	
2	FLUORENE	< 1.40E+00	< 6.70E-01	
2	GAMMA-BHC(LINDANE)		< 1.00E-02	
2	HEPTACHLOR		< 1.00E-02	
2	HEPTACHLOR EPOXIDE		< 1.00E-02	
2	HEXACHLOROBENZENE	< 1.40E+00	< 6.70E-01	
2	HEXACHLOROBUTADIENE	< 1.40E+00	< 6.70E-01	
2	HEXACHLOROCYCLOPENTADIENE	< 1.40E+00	< 6.70E-01	
2	HEXACHLOROETHANE	< 1.40E+00	< 6.70E-01	
2	INDENO (1,2,3-CD) PYRENE	< 1.40E+00	< 6.70E-01	
2	ISOPHORONE	< 1.40E+00	< 6.70E-01	
2	METHYL BROMIDE		< 5.00E-02	
2	METHYL CHLORIDE		< 5.00E-02	
2	METHYLENE CHLORIDE		< 2.50E-01	
2	N-BUTYL BENZYL PHTHALATE	< 1.40E+00	< 6.70E-01	
2	N-NITROSODI-N-PROPYLAMINE	< 1.40E+00	< 6.70E-01	
2	N-NITROSODIMETHYLAMINE	< 1.40E+00	< 6.70E-01	
2	N-NITROSODIPHENYLAMINE	< 1.40E+00	< 6.70E-01	
2	NAPHTHALENE	< 1.40E+00	< 6.70E-01	
2	NITROBENZENE	< 1.40E+00	< 6.70E-01	
2	P,P'DDD		< 1.00E-02	
2	P,P'DDE		< 1.00E-02	
2	P,P'DDT		9.00E-02	
2	PARACHLOROMETA CRESOL		< 6.70E-01	
2	PCB-1254 (AROCLOR 1254)	1.20E+00	2.00E+00	
2	PCB-1260 (AROCLOR 1260)	1.60E+00	3.60E+00	
2	PENTACHLOROPHENOL		< 6.70E-01	
2	PHENANTHRENE	< 1.40E+00	< 6.70E-01	
2	PYRENE	< 1.40E+00	< 6.70E-01	
2	TETRACHLOROETHYLENE		< 5.00E-02	
2	TOLUENE		< 5.00E-02	
2	TOXAPHENE		< 5.00E-01	
2	TRANS-1,2-DICHLOROETHENE		< 5.00E-02	
2	TRICHLOROETHYLENE		< 5.00E-02	< 5.00E-03
2	TRICHLOROFLUOROMETHANE		< 5.00E-02	
2	VINYL CHLORIDE		< 5.00E-02	
3	1,1,1-TRICHLOROETHANE		< 5.00E-02	9.00E-02
3	1,1,2,2-TETRACHLOROETHANE		< 5.00E-02	< 5.00E-03
3	1,1,2-TRICHLOROETHANE		< 5.00E-02	
3	1,1-DICHLOROETHANE		< 5.00E-02	< 5.00E-03
3	1,1-DICHLOROETHYLENE		< 5.00E-02	< 5.00E-03
3	1,2,4-TRICHLOROBENZENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	1,2,5,6-DIBENZANTHRACENE	< 1.70E+00	< 6.70E-01	
3	1,2-DICHLOROBENZENE	< 1.70E+00	< 6.70E-01	< 8.00E-03

Table B2 (continued)

Reach	Inorganic Compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
3	1,2-DICHLOROETHANE		< 5.00E-02	< 5.00E-03
3	1,2-DICHLOROPROPANE		< 5.00E-02	< 5.00E-03
3	1,2-DIPHENYLHYDRAZINE	< 1.70E+00	< 6.70E-01	
3	1,3-DICHLOROBENZENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	1,3-DICHLOROPROPENE		< 5.00E-02	
3	1,4-DICHLOROBENZENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	2,4,6-TRICHLOROPHENOL		< 6.70E-01	< 8.00E-03
3	2,4-DICHLOROPHENOL		< 6.70E-01	< 8.00E-03
3	2,4-DIMETHYLPHENOL		< 6.70E-01	< 8.00E-03
3	2,4-DINITROPHENOL		< 6.70E+00	< 2.90E-02
3	2,4-DINITROTOLUENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	2,6-DINITROTOLUENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	2-CHLOROETHYL VINYL ETHER		< 5.00E-02	< 1.00E-02
3	2-CHLORONAPHTHALENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	2-CHLOROPHENOL		< 6.70E-01	< 8.00E-03
3	2-NITROPHENOL		< 6.70E-01	< 8.00E-03
3	3,3'-DICHLOROBENZIDINE	< 4.00E+00	< 1.70E+00	< 1.70E-02
3	4,6-DINITRO-ORTHO-CRESOL		< 3.40E+00	< 2.90E-02
3	4-BROMOPHENYL PHENYL ETHER	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	4-CHLOROPHENYL PHENYL ETHER	< 1.70E+00	< 6.70E-01	< 2.50E-02
3	4-NITROPHENOL		< 6.70E-01	4.20E-02
3	ACENAPHTHENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	ACENAPHTHYLENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	ACROLEIN		< 5.00E-02	
3	ACRYLONITRILE		< 5.00E-02	
3	ALDRIN		< 1.00E-02	
3	ALPHA BHC		< 1.00E-02	
3	ANTHRACENE	5.00E-01	< 6.70E-01	< 8.00E-03
3	BENZENE		< 5.00E-02	< 5.00E-03
3	BENZIDINE	<** 8.00E+00	< 3.40E+00	< 8.00E-03
3	BENZO(A)ANTHRACENE	5.00E-01	< 6.70E-01	< 8.00E-03
3	BENZO(B)FLUORANTHENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	BENZO(GH)PERYLENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	BENZO(K)FLUOR ANTHENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	BENZO-A-PYRENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	BETA BHC		< 1.00E-02	
3	BIS (2-CHLOROETHOXY) METHANE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	BIS (2-CHLOROETHYL) ETHER	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	BIS (2-CHLOROISOPROPYL) ETHER	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	BIS (2-ETHYLHEXYL) PHTHALATE	9.67E+01	< 6.70E-01	8.30E-02
3	BIS (CHLOROMETHYL) ETHER		< 5.00E-02	
3	BROMOFORM		< 5.00E-02	< 5.00E-03
3	BUTYLBENZYLPHTHALATE			< 8.00E-03
3	CARBON TETRACHLORIDE		< 5.00E-02	1.90E-02

Table B2 (continued)

Reach	Inorganic Compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
3	CHLORDANE		< 1.00E-01	
3	CHLOROBENZENE		< 5.00E-02	< 5.00E-03
3	CHLORODIBROMOMETHANE		< 5.00E-02	
3	CHLOROETHANE		< 5.00E-02	< 1.00E-02
3	CHLOROFORM		< 5.00E-02	5.10E-02
3	CHRYSENE	7.00E-01	< 6.70E-01	< 8.00E-03
3	CIS-1,3-DICHLOROPROPENE			< 5.00E-03
3	DELTA BHC		< 1.00E-02	
3	DI-N-BUTYL PHTHALATE	3.00E-01	< 6.70E-01	< 8.00E-03
3	DI-N-OCTYL PHTHALATE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	DIBENZ(A,H)ANTHRACENE			< 8.00E-03
3	DICHLOROBROMOMETHANE		< 5.00E-02	< 5.00E-03
3	DICHLORODIFLUOROMETHANE		< 5.00E-02	1.50E-01
3	DIELDRIN		< 1.00E-02	
3	DIETHYL PHTHALATE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	DIMETHYL PHTHALATE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	ENDOSULFAN SULFATE		< 1.00E-02	
3	ENDOSULFAN, ALPHA		< 1.00E-02	
3	ENDOSULFAN, BETA		< 1.00E-02	
3	ENDRIN		< 1.00E-02	
3	ENDRIN ALDEHYDE		< 1.00E-02	
3	ETHYLBENZENE		< 5.00E-02	< 5.00E-03
3	FLUORANTHENE	3.80E+00	< 6.70E-01	< 8.00E-03
3	FLUORENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	GAMMA-BHC(LINDANE)		< 1.00E-02	
3	HEPTACHLOR		< 1.00E-02	
3	HEPTACHLOR EPOXIDE		< 1.00E-02	
3	HEXACHLOROBENZENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	HEXACHLOROBUTADIENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	HEXACHLOROCYCLOPENTADIENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	HEXACHLOROETHANE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	INDENO (1,2,3-CD) PYRENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	ISOPHORONE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	METHYL BROMIDE		< 5.00E-02	< 1.00E-02
3	METHYL CHLORIDE		< 5.00E-02	< 1.00E-02
3	METHYLENE CHLORIDE		< 2.50E-01	2.40E-01
3	N-BUTYL BENZYL PHTHALATE	< 1.70E+00	< 6.70E-01	
3	N-NITROSODI-N-PROPYLAMINE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	N-NITROSODIMETHYLAMINE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	N-NITROSODIPHENYLAMINE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	NAPHTHALENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	NITROBENZENE	< 1.70E+00	< 6.70E-01	< 8.00E-03
3	P,P'DDD		< 1.00E-02	
3	P,P'DDE		< 1.00E-02	
3	P,P'DDT		< 1.00E-02	

Table B2 (continued)

Reach	Inorganic Compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
3	PARACHLOROMETA CRESOL		< 6.70E-01	
3	PCB-1254 (AROCLOR 1254)	< 1.00E-01	6.00E-01	2.04E-02
3	PCB-1260 (AROCLOR 1260)	< 1.00E-01	2.80E+00	< 6.00E-03
3	PENTACHLOROPHENOL		< 6.70E-01	
3	PHENANTHRENE	2.70E+00	< 6.70E-01	< 8.00E-03
3	PYRENE	4.80E+00	< 6.70E-01	< 8.00E-03
3	TETRACHLOROETHYLENE		< 5.00E-02	9.60E-02
3	TOLUENE		< 5.00E-02	< 5.00E-03
3	TOXAPHENE		< 5.00E-01	
3	TRANS-1,3-DICHLOROPROPENE			1.70E-02
3	TRANS-1,2-DICHLOROETHENE		< 5.00E-02	1.20E-01
3	TRICHLOROETHYLENE		< 5.00E-02	5.10E-01
3	TRICHLOROFUOROMETHANE		< 5.00E-02	4.80E-02
3	VINYL CHLORIDE		< 5.00E-02	1.20E-02
4	1,2,4-TRICHLOROBENZENE	< 1.80E+00		
4	1,2,5,6-DIBENZANTHRACENE	< 1.80E+00		
4	1,2-DICHLOROBENZENE	< 1.80E+00		
4	1,2-DIPHENYLHYDRAZINE	< 1.80E+00		
4	1,3-DICHLOROBENZENE	< 1.80E+00		
4	1,4-DICHLOROBENZENE	< 1.80E+00		
4	2,4-DINITROTOLUENE	< 1.80E+00		
4	2,6-DINITROTOLUENE	< 1.80E+00		
4	2-CHLORONAPHTHALENE	< 1.80E+00		
4	3,3'-DICHLOROBENZIDINE	< 4.00E+00		
4	4-BROMOPHENYL PHENYL ETHER	< 1.80E+00		
4	4-CHLOROPHENYL PHENYL ETHER	< 1.80E+00		
4	ACENAPHTHENE	< 1.80E+00		
4	ACENAPHTHYLENE	< 1.80E+00		
4	ANTHRACENE	5.60E+00		
4	BENZIDINE	<** 9.00E+00		
4	BENZO(A)ANTHRACENE	3.80E+00		
4	BENZO(B)FLUORANTHENE	< 1.80E+00		
4	BENZO(GH)PERYLENE	< 1.80E+00		
4	BENZO(K)FLUOR ANTHENE	< 1.80E+00		
4	BENZO-A-PYRENE	< 1.80E+00		
4	BIS (2-CHLOROETHOXY) METHANE	< 1.80E+00		
4	BIS (2-CHLOROETHYL) ETHER	< 1.80E+00		
4	BIS (2-CHLOROISOPROPYL) ETHER	< 1.80E+00		
4	BIS (2-ETHYLHEXYL) PHTHALATE	2.00E-01		
4	CHLORDANE		2.98E-01	
4	CHRYSENE	5.40E+00		
4	DI-N-BUTYL PHTHALATE	< 1.80E+00		
4	DI-N-OCTYL PHTHALATE	< 1.80E+00		
4	DIETHYL PHTHALATE	< 1.80E+00		
4	DIMETHYL PHTHALATE	< 1.80E+00		

Table B2 (continued)

Reach	Inorganic Compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
4	FLUORANTHENE	< 1.80E+00		
4	FLUORENE	< 1.80E+00		
4	HEXACHLOROBENZENE	< 1.80E+00		
4	HEXACHLOROBUTADIENE	< 1.80E+00		
4	HEXACHLOROCYCLOPENTADIENE	< 1.80E+00		
4	HEXACHLOROETHANE	< 1.80E+00		
4	INDENO (1,2,3-CD) PYRENE	< 1.80E+00		
4	ISOPHORONE	< 1.80E+00		
4	N-BUTYL BENZYL PHTHALATE	< 1.80E+00		
4	N-NITROSODI-N-PROPYLAMINE	< 1.80E+00		
4	N-NITROSODIMETHYLAMINE	< 1.80E+00		
4	N-NITROSODIPHENYLAMINE	< 1.80E+00		
4	NAPHTHALENE	< 1.80E+00		
4	NITROBENZENE	< 1.80E+00		
4	PCB-1254 (AROCLOR 1254)	< 1.00E-01	1.10E+00	
4	PCB-1260 (AROCLOR 1260)	< 1.00E-01	1.20E+00	
4	PHENANTHRENE	5.40E+00	4.60E+00	
4	PYRENE	1.20E+01		
5	PCB-1254 (AROCLOR 1254)	< 1.00E-01	1.70E+00	
5	PCB-1260 (AROCLOR 1260)	< 1.00E-01	3.40E+00	
10	1,2,4-TRICHLOROBENZENE	< 1.50E+00		
10	1,2,5,6-DIBENZANTHRACENE	< 1.50E+00		
10	1,2-DICHLOROBENZENE	< 1.50E+00		
10	1,2-DIPHENYLHYDRAZINE	< 1.50E+00		
10	1,3-DICHLOROBENZENE	< 1.50E+00		
10	1,4-DICHLOROBENZENE	< 1.50E+00		
10	2,4-DINITROTOLUENE	< 1.50E+00		
10	2,6-DINITROTOLUENE	< 1.50E+00		
10	2-CHLORONAPHTHALENE	< 1.50E+00		
10	3,3'-DICHLOROBENZIDINE	< 3.80E+00		
10	4-BROMOPHENYL PHENYL ETHER	< 1.50E+00		
10	4-CHLOROPHENYL PHENYL ETHER	< 1.50E+00		
10	ACENAPHTHENE	< 1.50E+00		
10	ACENAPHTHYLENE	< 1.50E+00		
10	ANTHRACENE	< 1.50E+00		
10	BENZIDINE	< 7.50E+00		
10	BENZO(A)ANTHRACENE	< 1.50E+00		
10	BENZO(B)FLUORANTHENE	< 1.50E+00		
10	BENZO(GH)PERYLENE	< 1.50E+00		
10	BENZO(K)FLUOR ANTHENE	< 1.50E+00		
10	BENZO-A-PYRENE	< 1.50E+00		
10	BIS (2-CHLOROETHOXY) METHANE	< 1.50E+00		
10	BIS (2-CHLOROETHYL) ETHER	< 1.50E+00		
10	BIS (2-CHLOROISOPROPYL) ETHER	< 1.50E+00		
10	BIS (2-ETHYLHEXYL) PHTHALATE	< 1.50E+00		

Table B2 (continued)

Reach	Inorganic Compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
10	CHRYSENE	< 1.50E+00		
10	DI-N-BUTYL PHTHALATE	< 1.50E+00		
10	DI-N-OCTYL PHTHALATE	< 1.50E+00		
10	DIETHYL PHTHALATE	< 1.50E+00		
10	DIMETHYL PHTHALATE	< 1.50E+00		
10	FLUORANTHENE	< 1.50E+00		
10	FLUORENE	< 1.50E+00		
10	HEXACHLOROBENZENE	< 1.50E+00		
10	HEXACHLOROBUTADIENE	< 1.50E+00		
10	HEXACHLOROCYCLOPENTADIENE	< 1.50E+00		
10	HEXACHLOROETHANE	< 1.50E+00		
10	INDENO (1,2,3-CD) PYRENE	< 1.50E+00		
10	ISOPHORONE	< 1.50E+00		
10	N-BUTYL BENZYL PHTHALATE	< 1.50E+00		
10	N-NITROSODI-N-PROPYLAMINE	< 1.50E+00		
10	N-NITROSODIMETHYLAMINE	< 1.50E+00		
10	N-NITROSODIPHENYLAMINE	< 1.50E+00		
10	NAPHTHALENE	< 1.50E+00		
10	NITROBENZENE	< 1.50E+00		
10	PCB-1254 (AROCLOR 1254)	< 1.00E-01		
10	PCB-1260 (AROCLOR 1260)	< 1.00E-01		
10	PHENANTHRENE	< 1.50E+00		
10	PYRENE	< 1.50E+00		
18	PCB-1254 (AROCLOR 1254)		5.00E-01	
18	PCB-1260 (AROCLOR 1260)		< 1.00E-01	

< = below limits of detection.

<** = detected as present, but not quantified.

Table B3. Maximum concentrations of radionuclides
in sediment, fish, and water

Reach	Radionuclide	Sediment (Bq/kg, dry)	Fish (Bq/kg, wet)	Water (Bq/L)
1	Co-60	7.77E+00	7.70E-01	< 9.25E-02
1	Cs-137	4.81E+01	8.10E+00	9.25E-02
1	Np-237	< 9.99E-01		
1	Pa-234	1.48E+02		
1	Pu-238	7.40E-02	2.60E-02	
1	Pu-239	5.55E-01	6.00E-03	
1	Sr-89	7.40E+00		
1	Sr-90	3.70E+00	2.80E-01	1.41E-01
1	Tc-99	< 2.81E+01	1.48E+00	
1	Th-232	2.59E+01		
1	U-234	2.00E+01	1.93E-01	5.18E-03
1	U-235	7.77E+00	5.20E-02	1.85E-03
1	U-236			6.20E-06
1	U-238	1.30E+01	1.26E-01	3.33E-03
2	Am-241	2.70E+03		1.30E-01
2	Cm-244	4.44E+02		
2	Co-60	1.62E+04	3.40E+00	1.40E+00
2	Cs-134	6.29E+01		
2	Cs-137	1.74E+06	3.80E+02	1.10E+01
2	Eu-152	3.29E+02		
2	Eu-154	5.18E+02		
2	H-3			7.10E+04
2	Np-237		<	7.40E-02
2	Pa-234	4.81E+01		
2	Pu-238	1.52E+02	2.80E-02	2.00E-01
2	Pu-239	2.55E+03	1.90E+00	2.80E-02
2	Sr-89	<** 6.33E+03	<** 1.18E+01	
2	Sr-90	2.96E+04	1.54E+01	1.50E+01
2	Tc-99		<	1.85E+01
2	Th-234	1.48E+02		
2	U-234		1.87E-01	3.70E-03
2	U-235	7.77E+01	1.60E-02	1.85E-03
2	U-236			1.30E-05
2	U-238	9.07E+02	1.23E-01	2.52E-03
3	Am-241	1.22E+00		
3	Cm-244	2.96E-01		
3	Co-60	1.18E+03		
3	Cs-134	5.92E+00		
3	Cs-137	2.33E+02	<	3.70E+00
3	Np-237		<	7.40E-02

Table B3 (continued)

Reach	Radionuclide	Sediment (Bq/kg, dry)	Fish (Bq/kg, wet)	Water (Bq/L)
3	Pa-233	1.11E+00		
3	Pa-234	2.59E+02		
3	Pu-238	2.96E-01		
3	Pu-239	1.52E+00		
3	Sr-89	3.70E+00		
3	Sr-90	7.40E+00	5.28E-01	
3	Tc-99		3.70E+00	< 1.85E+01
3	Th-234	2.22E+02		
3	U-235	2.78E+02		
3	U-238	3.05E+03		
4	Am-241	1.96E+02		
4	Cm-244	3.33E+00		
4	Co-60	2.92E+02	7.47E-01	< 9.25E-02
4	Cs-137	1.19E+04	6.10E+01	< 9.25E-02
4	i ³ -3			5.55E+01
4	Np-237			< 7.40E-02
4	Pu-238	1.44E+01	3.30E-02	
4	Pu-239	1.89E+02	3.30E-02	< 1.11E-01
4	Sr-89	7.40E+01	7.40E-01	
4	Sr-90	4.33E+02	5.76E+00	1.59E-01
4	Tc-99		2.96E+00	< 1.85E+01
4	Th-234	1.48E+02		
4	U-234		1.08E+00	3.70E-03
4	U-235	1.70E+02	3.15E-01	1.90E-03
4	U-236			2.18E-05
4	U-238	3.55E+03	4.40E-01	2.26E-03
5	Co-60	1.48E+02		
5	Cs-137	5.16E+03		
5	Pu-238	6.29E-01		
5	Pu-239	1.18E+01		
5	Sr-90	1.11E+02		
10	Am-241	4.81E-01		
10	Cm-244	1.85E-01		
10	Cs-137	3.33E+01		
10	Sr-89	1.48E+02		
10	Sr-90	1.48E+01		
18	Cs-137	1.50E+01		

< = less than detection limit.

<** = present, but below the detection limit.

Table B4. Mean concentrations of inorganic chemicals
in sediment, fish, and water

Reach	Inorganic compound	N	Sediment (mg/kg, dry)	N	Fish (mg/kg, wet)	N	Water (mg/L)
1	ANTIMONY	1	3.00E-01	2	1.00E+00		
1	ARSENIC	2	1.45E+01	35	8.43E-02	118	2.06E-01
1	BERYLLIUM	2	1.60E+00	13	2.92E-02		
1	CADMIUM	1	5.00E-01	67	1.33E-02		
1	CHROMIUM	2	2.20E+01	84	6.54E-02	118	6.00E-03
1	COPPER	2	4.40E+01	20	6.49E-01	118	3.00E-03
1	CYANIDE	1	4.00E-01				
1	LEAD	2	4.85E+01	29	2.29E-01		
1	MERCURY	2	1.05E-01	87	8.79E-02	119	
1	NICKEL	2	2.33E+01	9	1.00E+00	118	8.00E-03
1	SELENIUM	1	2.00E+00	29	6.76E-01	118	2.00E-02
1	SILVER			11	2.91E-01		
1	THALLIUM			4	2.20E+00		
1	URANIUM	1	5.90E+00				
1	ZINC	2	1.35E+02	29	7.30E+00	118	4.00E-03
1	ZIRCONIUM	1	2.30E+02				
2	ALUMINUM	4	7.15E+03			167	5.46E-01
2	ANTIMONY			1	1.00E+00		
2	ARSENIC	5	8.86E+00	25	2.26E-01	81	2.03E-02
2	BERYLLIUM			4	2.50E-02	10	9.20E-04
2	CADMIUM	6	1.66E+00	17	7.24E-03	40	2.23E-03
2	CHROMIUM	11	5.18E+01	17	9.00E-02	54	1.50E-02
2	COPPER	6	1.27E+01	11	1.63E+00	91	2.06E-02
2	CYANIDE					24	5.50E-03
2	LEAD	11	2.57E+01	10	1.72E-01	91	8.08E-03
2	MERCURY	7	1.96E+00	77	8.36E-02	71	1.50E-04
2	NICKEL	11	1.81E+01	1	1.00E+00	82	2.81E-02
2	SELENIUM	2	7.45E+01	11	2.61E-01		
2	SILVER	4	4.20E+00	4	3.75E-01	10	1.00E-03
2	THALLIUM			1	1.00E+00		
2	URANIUM	10	2.22E+00				
2	ZINC	6	5.25E+01	12	7.33E+00	90	3.20E-02
2	ZIRCONIUM	5	5.13E+02				
3	ALUMINUM	24	2.08E+04			444	3.59E-01
3	ANTIMONY			2	1.00E+00	219	5.20E-02
3	ARSENIC	7	2.32E+01	30	2.20E-01	195	8.40E-03
3	BARIUM						
3	BERYLLIUM			4	2.50E-02	510	1.00E-03
3	BORON					226	1.94E-01
3	CADMIUM	17	1.96E+00	28	9.93E-03	655	2.89E-03

Table B4 (continued)

Reach	Inorganic compound		N	Sediment (mg/kg, dry)		N	Fish (mg/kg, wet)		N	Water (mg/L)
3	CHROMIUM		46	4.58E+01		30	1.62E-01		640	1.18E-02
3	COPPER		43	5.47E+01		14	7.84E-01		363	9.96E-03
3	CYANIDE								195	1.76E-02
3	LEAD		46	3.18E+01		14	8.86E-02		664	1.23E-02
3	MERCURY		45	1.10E+01		40	4.90E-01		543	8.84E-06
3	MOLYBDENUM								226	1.10E-02
3	NICKEL		46	1.23E+02		2	1.50E+00		359	9.59E-02
3	NIOBIUM								122	8.00E-03
3	SELENIUM		15	8.71E+01		15	2.79E-01			
3	SILVER		15	5.22E+00		2	4.00E-01		514	1.00E-02
3	THALLIUM					3	1.00E+00			
3	TIN								110	1.09E-02
3	TITANIUM								226	5.63E-03
3	URANIUM		28	1.78E+01					190	2.37E-01
3	ZINC		43	1.39E+02		15	7.95E+00		595	3.69E-02
3	ZIRCONIUM		3	3.43E+02					122	4.70E-03
4	ALUMINUM		5	1.79E+04						
4	ANTIMONY									
4	ARSENIC		2	8.05E+00		28	1.79E-01		48	5.00E-03
4	BARIUM		1	4.36E+02						
4	BERYLLIUM		1	2.41E+00						
4	BORON		1	1.41E+02						
4	CADMUM		3	9.50E-01		39	8.59E-03		48	2.00E-03
4	CHROMIUM		9	1.68E+01		38	1.11E-01			
4	COPPER		6	1.80E+01		2	4.80E-01		145	1.59E-02
4	CYANIDE								48	4.25E-03
4	LEAD		9	1.57E+01		4	1.90E-01		48	4.97E-03
4	MERCURY		10	2.96E+00		115	1.88E-01		24	2.00E-04
4	NICKEL		9	1.85E+01		1	1.00E+00		48	5.05E-02
4	SELENIUM		2	1.12E+02		4	1.35E+00			
4	SILVER		2	2.55E+00						
4	TITANIUM		1	3.91E+03						
4	URANIUM		6	2.67E+00					33	2.36E-03
4	VANADIUM		1	9.21E+01						
4	ZINC		7	5.37E+01		4	1.04E+01		48	3.08E-02
4	ZIRCONIUM		3	3.73E+02						
5	ALUMINUM								4	1.70E-01
5	ARSENIC		1	1.60E+01		4	2.00E-01			
5	BERYLLIUM		1	1.60E+00						
5	CADMUM					10	1.50E-02			
5	CHROMIUM		4	3.61E+01		8	2.30E-01			

Table B4 (continued)

Reach	Inorganic compound		Sediment <i>N</i> (mg/kg, dry)		Fish <i>N</i> (mg/kg, wet)		Water <i>N</i> (mg/L)
5	COPPER	1	4.00E+01				
5	LEAD	1	5.30E+01				
5	MERCURY	15	7.01E-01	7	1.34E-01		
5	NICKEL	1	2.40E+01				
5	SELENIUM	1	8.00E-01				
5	SILVER						
5	ZINC	1	2.20E+02				
10	ARSENIC	2	2.00E+01				
10	CADMUM						
10	CHROMIUM	2	2.20E+01				
10	CYANIDE						
10	LEAD	2	6.25E+01				
10	MERCURY	2	1.00E-01				
10	NICKEL	2	2.55E+01				
10	SILVER						
10	URANIUM	2	4.25E+00				
10	ZIRCONIUM	2	1.95E+02				
13	ARSENIC				24	5.50E-03	
13	COPPER				24	3.00E-03	
13	CYANIDE				24	5.50E-03	
13	LEAD				24	6.00E-03	
13	NICKEL				24	5.00E-02	
13	URANIUM				23	5.70E-03	
13	ZINC				24	2.65E-02	
18	ARSENIC			3	2.00E-01		
18	CADMUM			14	6.21E-03		
18	CHROMIUM			13	2.15E-01		
18	MERCURY			11	2.14E-01		

N = Number of observations that make up the mean value.

Table B5. Mean concentrations of organic chemicals
in sediment, fish, and water

Reach	Organic compound		Sediment N (mg/kg, dry)	Fish N (mg/kg, wet)	Water N (mg/L)
1	BIS (2-ETHYLHEXYL) PHTHALATE	1	2.20E+00		
1	CHLORDANE			2 1.60E-01	
1	FLUORANTHENE	1	5.90E-01		
1	METHYLENE CHLORIDE	1	1.00E-01		
1	P,P'DDD			1 1.00E-01	
1	PCB-1254 (AROCLOR 1254)			60 1.38E-01	
1	PCB-1260 (AROCLOR 1260)			61 2.56E-01	
2	BIS (2-ETHYLHEXYL) PHTHALATE	2	1.75E+00		
2	CHLORDANE			1 2.50E-01	
2	P,P'DDT			1 9.00E-02	
2	PCB-1254 (AROCLOR 1254)	1	1.20E+00	97 3.78E-01	
2	PCB-1260 (AROCLOR 1260)	1	1.60E+00	97 6.38E-01	
3	1,1,1-TRICHLOROETHANE				1146 5.11E-03
3	4-NITROPHENOL				13 2.62E-02
3	ANTHRACENE	8	2.40E-01		
3	BENZO(A)ANTHRACENE	1	5.00E-01		
3	BIS (2-ETHYLHEXYL) PHTHALATE	12	9.05E+00		11 6.70E-03
3	CARBON TETRACHLORIDE				301 5.16E-03
3	CHRYSENE	1	7.00E-01		
3	DI-N-BUTYL PHTHALATE	7	1.30E-01		
3	DICHLORODIFLUOROMETHANE				11 1.08E-02
3	FLUORANTHENE	11	6.70E-01		
3	METHYLENE CHLORIDE				845 5.31E-03
3	PCB-1254 (AROCLOR 1254)			5 4.20E-01	136 1.42E-03
3	PCB-1260 (AROCLOR 1260)			6 1.43E+00	
3	PHENANTHRENE	12	5.80E-01		
3	PYRENE	10	7.20E-01		
3	TETRACHLOROETHYLENE				845 5.07E-03
3	TRICHLOROETHYLENE				810 2.50E-02
3	TRICHLOROFUOROMETHANE				52 4.70E-03
3	VINYL CHLORIDE				301 6.02E-03
4	CHLORDANE			5 2.98E-01	
4	PCB-1254 (AROCLOR 1254)			72 3.64E-01	
4	PCB-1260 (AROCLOR 1260)			54 3.57E-01	
5	PCB-1254 (AROCLOR 1254)			37 6.27E-01	
5	PCB-1260 (AROCLOR 1260)			33 8.79E-01	
18	PCB-1254 (AROCLOR 1254)			7 3.29E-01	
18	PCB-1260 (AROCLOR 1260)			10 1.00E-01	

N= Number of observations that make up the mean value.

Table B6. Mean concentrations of radionuclides
in sediment, fish, and water

Reach	Radionuclide	Sediment		Fish		Water	
		N	(Bq/kg, dry)	N	(Bq/kg, wet)	N	(Bq/L)
1	Co-60	1	7.77E+00	25	2.10E-01		
1	Cs-137	2	3.61E+01	29	1.14E+00	4	9.25E-02
1	Pa-234	2	7.96E+01				
1	Pu-238	1	7.40E-02	13	4.00E-03		
1	Pu-239	1	5.55E-01	13	2.00E-03		
1	Sr-89	1	7.40E+00				
1	Sr-90	2	2.90E+00	47	1.64E-01	4	9.25E-02
1	Tc-99			4	8.88E-01		
1	Th-232	1	2.59E+01				
1	U-234	1	2.00E+01	8	6.40E-02	4	4.44E-03
1	U-235	1	7.77E+00	13	1.40E-02	4	1.85E-03
1	U-236					4	4.44E-06
1	U-238	1	1.30E+01	13	3.90E-02	4	2.74E-03
2	Am-241	6	3.86E+02			114	7.89E-03
2	Cm-244	4	1.17E+02			98	9.88E-03
2	Co-60	53	3.05E+02	22	9.89E-01	114	3.56E-01
2	Cs-134	4	3.05E+01				
2	Cs-137	69	6.52E+03	40	2.75E+01	114	1.75E+00
2	Eu-152	4	2.24E+02				
2	Eu-154	4	2.18E+02				
2	Pa-234	1	4.81E+01				
2	Pu-238	35	9.33E-01	20	4.00E-03	114	9.57E-04
2	Pu-239	37	9.00E+00	20	9.70E-02	114	1.95E-03
2	Sr-89	3	1.86E+02	1	1.18E+01		
2	Sr-90	39	1.04E+02	80	2.40E+00	119	4.89E+00
2	Th-234	3	4.44E+01				
2	H-3					119	8.68E+03
2	U-234			20	5.20E-02	4	2.92E-03
2	U-235	6	3.21E+01	20	5.00E-03	4	1.85E-03
2	U-236					4	5.18E-06
2	U-238	6	4.32E+02	20	3.10E-02	4	2.07E-03
3	Am-241	2	1.04E+00				
3	Cm-244	2	2.59E-01				
3	Co-60	69	3.70E+01				
3	Cs-134	3	3.54E+00				
3	Cs-137	85	5.09E+01				
3	Pa-233	2	9.43E-01				
3	Pa-234	2	2.04E+02				
3	Pu-238	1	2.96E-01				
3	Pu-239	2	1.18E+00				

Table B6 (continued)

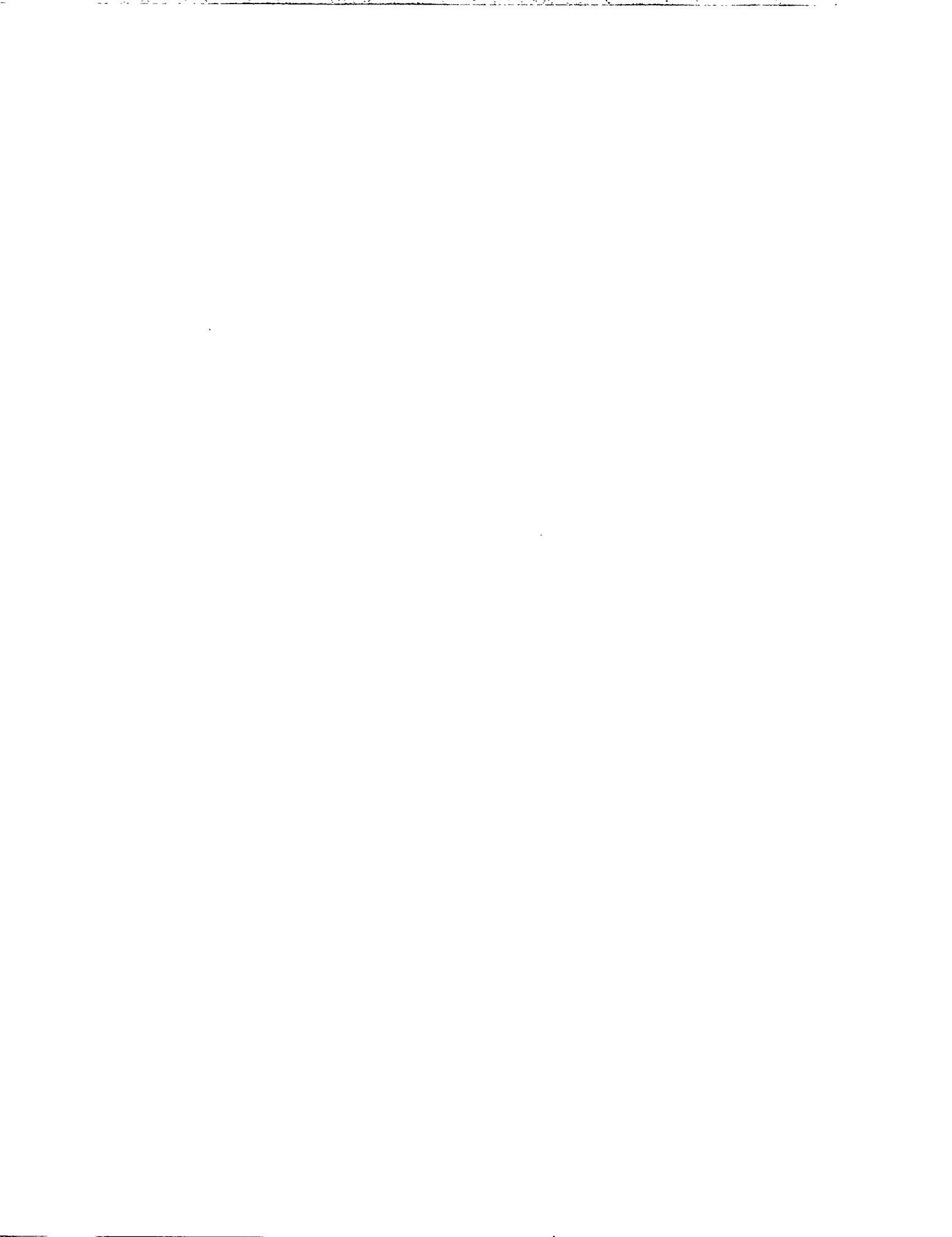
Reach	Radionuclide	Sediment		Fish		Water	
		N	(Bq/kg, dry)	N	(Bq/kg, wet)	N	(Bq/L)
3	Sr-90	4	6.48E+00	11	1.38E-01		
3	Tc-99			4	2.04E+00		
3	Th-234	4	1.34E+02				
3	U-235	9	8.16E+01				
3	U-238	13	8.68E+02				
4	Am-241	2	5.80E+00				
4	Cm-244	2	1.13E+00				
4	Co-60	39	3.35E+01	33	2.51E-01		
4	Cs-137	52	6.03E+02	49	5.74E+00		
4	Pu-238	34	4.44E-01	33	3.00E-03		
4	Pu-239	34	5.60E+00	33	3.00E-03		
4	Sr-89	2	1.57E+01	1	7.40E-01		
4	Sr-90	34	2.54E+01	58	5.30E-01	4	1.11E-01
4	Tc-99			4	2.22E+00		
4	Th-234	2	8.23E+01				
4	H-3					4	5.55E+01
4	U-234			33	1.44E-01	4	2.92E-03
4	U-235	2	3.31E+01	33	2.00E-02	4	1.85E-03
4	U-236					4	1.07E-05
4	U-238	3	2.92E+02	33	8.70E-02	4	1.96E-03
5	Co-60	189	5.53E+00				
5	Cs-137	201	7.81E+01				
5	Pu-238	6	1.20E-01				
5	Pu-239	6	1.19E+00				
5	Sr-90	6	2.47E+01				
10	Am-241	1	4.81E-01				
10	Cm-244	1	1.85E-01				
10	Cs-137	2	3.15E+01				
10	Sr-89	2	9.25E+01				
10	Sr-90	2	7.40E+00				
18	Cs-137	6	9.13E+00				

N= Number of observations that make up the mean value.



Appendix C

RESULTS OF CONSERVATIVE SCREENING



**Table C1a. Summation screening indices for carcinogens by pathway and contaminant type
(Exposure pathways based on consumption of water and fish and
the assumed use of water for irrigation)**

Reach	Contaminant type	Fish ingestion	Water ingestion	Meat ingestion	Milk ingestion	Vegetable ingestion	Soil ingestion	Dust inhalation	External soil exposure	Multiple pathway total
R1	Inorganics	2.8E-04	9.0E-03	2.4E-05	1.3E-06	1.4E-02	7.1E-04	2.5E-04		2.4E-02
R1	Organics	1.4E-02	1.1E-04	1.1E-04	1.2E-04	5.2E-04	9.0E-06			1.5E-02
R1	Radionuclides	5.1E-06	1.1E-05	1.1E-05	1.7E-05	3.4E-05	6.7E-07	6.7E-07	5.0E-06	8.5E-05
R1	Pathway total	1.4E-02	9.1E-03	1.5E-04	1.4E-04	1.4E-02	7.2E-04	2.5E-04	5.0E-06	3.9E-02
R2	Inorganics	2.5E-04	2.3E-02	6.0E-05	3.2E-06	3.4E-02	1.8E-03	6.4E-04		6.0E-02
R2	Organics	1.2E-02	6.8E-05	4.4E-05	4.6E-05	2.4E-04	5.4E-06			1.3E-02
R2	Radionuclides	3.4E-04	3.1E-03	1.3E-03	2.3E-03	4.0E-03	7.7E-05	7.8E-05	7.4E-04	1.2E-02
R2	Pathway total	1.3E-02	2.6E-02	1.4E-03	2.4E-03	3.9E-02	1.9E-03	7.2E-04	7.4E-04	8.4E-02
R3	Inorganics	3.5E-04	6.7E-04	8.0E-05	2.6E-07	1.0E-03	5.3E-05	6.5E-05		2.3E-03
R3	Organics	2.1E-02	6.4E-03	6.8E-03	7.1E-03	1.8E-02	5.1E-04			5.9E-02
R3	Radionuclides	7.7E-05	3.4E-04	3.6E-04	7.8E-05	5.3E-04	2.7E-05	1.4E-04	4.9E-05	1.6E-03
R3	Pathway total	2.1E-02	7.4E-03	7.2E-03	7.2E-03	1.9E-02	5.9E-04	2.1E-04	4.9E-05	6.3E-02
R4	Inorganics	2.3E-04	1.5E-04	9.1E-06	3.1E-08	2.3E-04	1.2E-05	4.6E-05		6.8E-04
R4	Organics	1.6E-01	3.5E-03	6.2E-04	6.6E-04	6.1E-03	2.8E-04			1.7E-01
R4	Radionuclides	3.6E-05	1.8E-05	7.3E-06	1.6E-05	4.4E-05	9.0E-07	2.4E-06	1.9E-06	1.3E-04
R4	Pathway total	1.6E-01	3.6E-03	6.4E-04	6.7E-04	6.4E-03	2.9E-04	4.9E-05	1.9E-06	1.7E-01
R5	Inorganics	1.2E-04	5.0E-05	5.3E-06	1.3E-08	7.7E-05	4.0E-06	2.9E-06		2.6E-04
R5	Organics	1.1E-02	5.4E-07	3.1E-06	3.2E-06	8.4E-07	4.3E-08			1.1E-02
R5	Radionuclides	2.1E-04	6.6E-05	3.9E-05	1.0E-04	2.3E-04	3.7E-06	4.0E-07	9.1E-06	6.6E-04
R5	Pathway total	1.2E-02	1.2E-04	4.7E-05	1.0E-04	3.1E-04	7.7E-06	3.3E-06	9.1E-06	1.2E-02

Table C1a (continued)

Reach	Contaminant type	Fish ingestion	Water ingestion	Meat ingestion	Milk ingestion	Vegetable ingestion	Soil ingestion	Dust inhalation	External soil exposure	Multiple pathway total
R10	Inorganics	4.8E-04	6.0E-05	1.3E-07	8.5E-09	9.2E-05	4.8E-06	2.6E-06		6.4E-04
R10	Radionuclides	1.8E-05	1.4E-05	4.2E-06	1.4E-05	3.7E-05	4.8E-07	5.6E-08	1.6E-07	8.7E-05
R10	Pathway total	5.0E-04	7.4E-05	4.3E-06	1.4E-05	1.3E-04	5.2E-06	2.7E-06	1.6E-07	7.3E-04
R13	Inorganics	2.8E-03	3.5E-04	7.3E-07	4.9E-08	5.4E-04	2.8E-05	1.0E-05		3.7E-03
R13	Pathway total	2.8E-03	3.5E-04	7.3E-07	4.9E-08	5.4E-04	2.8E-05	1.0E-05		3.7E-03
R18	Inorganics	1.5E-04	1.9E-05	3.9E-08	2.6E-09	2.9E-05	1.5E-06	2.9E-06		2.0E-04
R18	Organics	1.1E-03	2.4E-06	7.0E-06	7.3E-06	3.8E-06	1.9E-07			1.1E-03
R18	Radionuclides	3.9E-07	9.8E-09	3.1E-08	2.7E-08	1.5E-08	5.7E-10	4.2E-12	2.6E-08	5.0E-07
R18	Pathway total	1.3E-03	2.1E-05	7.0E-06	7.4E-06	3.2E-05	1.7E-06	2.9E-06	2.6E-08	1.3E-03

**Table C1b. Summation screening indices for carcinogens by pathway and contaminant type
(Exposure pathways based on assumed dredging of sediment
and its subsequent use as agricultural soil)**

Reach	Contaminant type	Vegetable ingestion	Sediment ingestion	Dust inhalation	Milk ingestion	Meat ingestion	External sediment	Multiple pathway total
R1	Inorganics	5.5E-03	5.2E-05	3.3E-05	8.9E-07	3.7E-04		5.9E-03
R1	Organics	3.0E-03	2.5E-05		3.3E-03	3.2E-03		9.4E-03
R1	Radionuclides	3.7E-04	3.4E-06	2.2E-05	3.9E-05	6.6E-05	8.5E-04	1.3E-03
R1	Pathway total	8.8E-03	8.1E-05	5.5E-05	3.4E-03	3.6E-03	8.5E-04	1.7E-02
R2	Inorganics	5.8E-03	5.5E-05	2.1E-04	1.5E-06	9.2E-04		7.0E-03
R2	Organics	3.3E-03	3.1E-05		4.8E-02	4.6E-02		9.7E-02
R2	Radionuclides	7.0E-01	3.9E-03	1.4E-03	9.1E-01	9.8E-01	2.6E+00	5.2E+00
R2	Pathway total	7.1E-01	4.0E-03	1.6E-03	9.6E-01	1.0E+00	2.6E+00	5.3E+00
R3	Inorganics	3.4E-02	3.2E-04	2.7E-04	8.9E-06	5.5E-03		4.0E-02
R3	Organics	3.7E-02	2.5E-04		5.5E-03	5.2E-03		4.8E-02
R3	Radionuclides	3.9E-03	3.6E-05	1.8E-04	7.5E-04	3.2E-03	9.3E-03	1.7E-02
R3	Pathway total	7.5E-02	6.1E-04	4.5E-04	6.2E-03	1.4E-02	9.3E-03	1.1E-01
R4	Inorganics	4.6E-03	4.4E-05	7.2E-05	1.1E-06	6.2E-04		5.4E-03
R4	Organics	7.0E-02	5.3E-04		2.4E-02	2.3E-02		1.2E-01
R4	Radionuclides	1.2E-02	8.4E-05	3.0E-04	7.3E-03	9.7E-03	2.0E-02	4.9E-02
R4	Pathway total	8.6E-02	6.6E-04	3.7E-04	3.1E-02	3.3E-02	2.0E-02	1.7E-01
R5	Inorganics	5.2E-03	5.0E-05	5.0E-05	8.6E-07	3.7E-04		5.7E-03
R5	Radionuclides	2.1E-03	1.1E-05	3.1E-06	2.8E-03	3.0E-03	8.4E-03	1.6E-02
R5	Pathway total	7.3E-03	6.1E-05	5.3E-05	2.8E-03	3.4E-03	8.4E-03	2.2E-02

Table C1b (continued)

Reach	Contaminant type	Vegetable ingestion	Sediment ingestion	Dust inhalation	Milk ingestion	Meat ingestion	External sediment	Multiple pathway total
R10	Inorganics	6.2E-03	6.0E-05	3.6E-05	5.7E-07	8.5E-06		6.3E-03
R10	Radionuclides	1.2E-04	3.1E-07	1.5E-07	7.8E-05	4.9E-05	1.1E-04	3.6E-04
R10	Pathway total	6.3E-03	6.0E-05	3.6E-05	7.8E-05	5.7E-05	1.1E-04	6.7E-03
R13	Inorganics	3.6E-02	3.5E-04	1.2E-04	3.3E-06	4.9E-05		3.7E-02
R13	Pathway total	3.6E-02	3.5E-04	1.2E-04	3.3E-06	4.9E-05		3.7E-02
R18	Inorganics	1.9E-03	1.9E-05	6.7E-05	1.8E-07	2.6E-06		2.0E-03
R18	Organics	5.8E-04	5.4E-06		1.1E-03	1.1E-03		2.7E-03
R18	Radionuclides	4.8E-06	3.0E-08	2.2E-10	7.4E-06	8.3E-06	2.2E-05	4.2E-05
R18	Pathway total	2.5E-03	2.4E-05	6.7E-05	1.1E-03	1.1E-03	2.2E-05	4.8E-03

Table C2a. Carcinogen screening indices for inorganic compounds using maximum concentrations and conservative estimates of exposure (Exposure pathways based on consumption of water and fish and the assumed use of water for irrigation)

Reach	Inorganic compound	Fish ingestion	Water ingestion	Meat ingestion	Milk ingestion	Vegetable ingestion	Soil ingestion	Dust inhalation	Multiple pathway total
R1									
1	ARSENIC	2.1E-04	9.0E-03	1.9E-05	1.3E-06	1.4E-02	7.1E-04	2.3E-04	2.4E-02
1	BERYLLIUM	7.4E-05	9.8E-06	5.2E-06	7.0E-09	1.5E-05	7.8E-07	1.8E-08	1.0E-04
1	CHROMIUM								1.1E-05
1	NICKEL								3.1E-07
1	CADMIUM								5.6E-08
1	URANIUM	9.4E-11	4.7E-10	5.0E-10	1.0E-10	7.3E-10	3.7E-11		1.9E-09
1	Pathway total	2.8E-04	9.0E-03	2.4E-05	1.3E-06	1.4E-02	7.1E-04	2.5E-04	2.4E-02
R2									
2	ARSENIC	2.0E-04	2.3E-02	4.7E-05	3.1E-06	3.4E-02	1.8E-03	5.9E-04	6.0E-02
2	BERYLLIUM	4.9E-05	2.6E-05	1.3E-05	1.7E-08	3.8E-05	1.9E-06	4.4E-08	1.3E-04
2	CHROMIUM								5.0E-05
2	NICKEL								1.2E-06
2	CADMIUM								1.2E-06
2	URANIUM	2.9E-10	1.4E-09	1.5E-09	3.0E-10	2.2E-09	1.1E-10		5.9E-09
2	Pathway total	2.5E-04	2.3E-02	6.0E-05	3.2E-06	3.4E-02	1.8E-03	6.4E-04	6.0E-02
R3									
3	ARSENIC	9.0E-04	6.3E-04	1.1E-06	7.3E-08	8.0E-04	4.2E-05	1.4E-05	1.7E-03
3	BERYLLIUM	4.9E-05	1.6E-04	7.9E-05	1.0E-07	2.3E-04	1.2E-05	2.6E-07	5.2E-04
3	NICKEL								2.5E-05
3	CHROMIUM								2.2E-05
3	CADMIUM								4.0E-06
3	URANIUM	7.9E-08	4.0E-07	4.2E-07	8.3E-08	6.1E-07	3.1E-08		1.6E-06
3	Pathway total	3.5E-04	6.7E-04	8.0E-05	2.6E-07	1.0E-03	5.3E-05	6.5E-05	2.3E-03

Table C2a (continued)

Reach	Inorganic compound	Fish ingestion	Water ingestion	Meat ingestion	Milk ingestion	Vegetable ingestion	Soil ingestion	Dust inhalation	Multiple pathway total
R4									
4	ARSENIC	2.0E-04	1.4E-04	2.8E-07	1.9E-08	2.1E-04	1.1E-05	3.5E-06	5.6E-04
4	BERYLLIUM	3.3E-05	1.6E-05	8.8E-06	1.2E-08	2.6E-05	1.3E-06	2.9E-08	8.5E-05
4	CHROMIUM								
4	NICKEL								
4	CADMIUM								
4	URANIUM	1.3E-10	6.3E-10	6.6E-10	1.3E-10	9.6E-10	5.0E-11	2.4E-07	2.4E-07
4	Pathway total	2.3E-04	1.5E-04	9.1E-06	3.1E-08	2.3E-04	1.2E-05	4.6E-05	2.6E-09
R5									
5	ARSENIC	1.0E-04	4.0E-05	8.4E-08	5.6E-09	6.1E-05	3.2E-06	1.0E-06	2.1E-04
5	BERYLLIUM	2.0E-05	9.8E-06	5.2E-06	7.0E-09	1.5E-05	7.8E-07	1.8E-08	5.1E-05
5	CHROMIUM								
5	NICKEL								
5	CADMIUM								
5	Pathway total	1.2E-04	5.0E-05	5.3E-06	1.3E-08	7.7E-05	4.0E-06	2.9E-06	2.6E-04
R10									
10	ARSENIC	4.8E-04	6.0E-05	1.3E-07	8.4E-09	9.2E-05	4.8E-06	1.6E-06	6.4E-04
10	CHROMIUM								
10	NICKEL								
10	URANIUM	6.9E-11	3.4E-10	3.6E-10	7.5E-11	5.3E-10	2.7E-11	3.7E-07	3.7E-07
10	Pathway total	4.8E-04	6.0E-05	1.3E-07	8.5E-09	9.2E-05	4.8E-06	2.6E-06	2.0E-08
R13									
13	ARSENIC	2.8E-03	3.5E-04	7.3E-07	4.9E-08	5.4E-04	2.8E-05	9.1E-06	3.7E-03
13	NICKEL								
13	Pathway total	2.8E-03	3.5E-04	7.3E-07	4.9E-08	5.4E-04	2.8E-05	1.0E-05	3.7E-03
R18									
18	ARSENIC	1.5E-04	1.9E-05	3.9E-08	2.6E-09	2.9E-05	1.5E-06	4.9E-07	2.0E-04
18	CHROMIUM								
18	CADMIUM								
18	Pathway total	1.5E-04	1.9E-05	3.9E-08	2.6E-09	2.9E-05	1.5E-06	2.9E-06	2.0E-04

Table C2b. Carcinogen screening indices for inorganic compounds using maximum concentrations and conservative estimates of exposure (Exposure pathways based on assumed dredging of sediment and its subsequent use as agricultural soil)

Reach	Inorganic compound	Vegetable ingestion	Sediment ingestion	Dust inhalation	Milk ingestion	Meat ingestion	Multiple pathway total
R1							
1	ARSENIC	4.4E-03	4.3E-05	1.4E-05	4.0E-07	6.0E-06	4.5E-03
1	BERYLLIUM	1.1E-03	9.8E-06	2.2E-07	4.9E-07	3.7E-04	1.5E-03
1	CHROMIUM			1.8E-05			1.8E-05
1	NICKEL			7.0E-07			7.0E-07
1	CADMIUM			5.0E-08			5.0E-08
1	URANIUM	5.0E-09	4.7E-11		6.8E-10	3.4E-09	9.1E-09
1	Pathway total	5.6E-03	6.2E-05	3.3E-05	8.9E-07	3.7E-04	5.9E-03
R2							
2	BERYLLIUM	2.7E-03	2.5E-05	5.5E-07	1.2E-06	9.1E-04	3.6E-03
2	ARSENIC	3.1E-03	3.0E-05	9.9E-06	2.8E-07	4.2E-06	3.1E-03
2	CHROMIUM			2.0E-04			2.0E-04
2	NICKEL			5.9E-07			5.9E-07
2	CADMIUM			4.2E-07			4.2E-07
2	URANIUM	1.5E-08	1.4E-10		2.1E-09	1.0E-08	2.8E-08
2	Pathway total	5.8E-03	5.5E-05	2.1E-04	1.5E-06	9.2E-04	7.0E-03
R3							
3	BERYLLIUM	1.6E-02	1.5E-04	3.3E-06	7.3E-06	5.5E-03	2.2E-02
3	ARSENIC	1.8E-02	1.7E-04	5.6E-05	1.6E-06	2.4E-05	1.8E-02
3	CHROMIUM			1.8E-04			1.8E-04
3	NICKEL			2.5E-05			2.5E-05
3	CADMIUM			3.5E-07			3.5E-07
3	URANIUM	1.5E-07	1.4E-09		2.1E-08	1.0E-07	2.8E-07
3	Pathway total	3.4E-02	3.2E-04	2.7E-04	8.9E-06	5.5E-03	4.0E-02

Table C2b (continued)

Reach	Inorganic compound	Vegetable ingestion	Sediment ingestion	Dust inhalation	Milk ingestion	Meat ingestion	Multiple pathway total
R4	ARSENIC	2.8E-03	2.8E-05	9.1E-06	2.6E-07	3.9E-06	2.9E-03
4	BERYLLIUM	1.8E-03	1.6E-05	3.7E-07	8.2E-07	6.1E-04	2.4E-03
4	CHROMIUM			6.1E-05			6.1E-05
4	NICKEL			1.1E-06			1.1E-06
4	CADMIUM			1.6E-07			1.6E-07
4	URANIUM	6.6E-09	6.3E-11		9.0E-10	4.5E-09	1.2E-08
4	Pathway total	4.6E-03	4.4E-05	7.2E-05	1.1E-06	6.2E-04	5.4E-03
R5	ARSENIC	4.1E-03	4.0E-05	1.3E-05	3.8E-07	5.6E-06	4.2E-03
5	BERYLLIUM	1.1E-03	9.8E-06	2.2E-07	4.9E-07	3.7E-04	1.5E-03
5	CHROMIUM			3.6E-05			3.6E-05
5	NICKEL			4.7E-07			4.7E-07
5	CADMIUM			7.5E-09			7.5E-09
5	Pathway total	5.2E-03	5.0E-05	5.0E-05	8.6E-07	3.7E-04	5.7E-03
R10	ARSENIC	6.2E-03	6.0E-05	2.0E-05	5.6E-07	8.5E-06	6.3E-03
10	CHROMIUM			1.5E-05			1.5E-05
10	NICKEL			5.3E-07			5.3E-07
10	URANIUM	3.6E-09	3.4E-11		5.0E-10	2.5E-09	6.6E-09
10	Pathway total	6.2E-03	6.0E-05	3.6E-05	6.7E-07	8.5E-06	6.3E-03
R13	ARSENIC	3.6E-02	3.5E-04	1.2E-04	3.3E-06	4.9E-05	3.7E-02
13	NICKEL			1.5E-06			1.5E-06
13	Pathway total	3.6E-02	3.5E-04	1.2E-04	3.3E-06	4.9E-05	3.7E-02
R18	ARSENIC	1.9E-03	1.9E-05	6.2E-06	1.8E-07	2.6E-06	2.0E-03
18	CHROMIUM			6.1E-05			6.1E-05
18	CADMIUM			1.5E-09			1.5E-09
18	Pathway total	1.9E-03	1.9E-05	6.7E-05	1.8E-07	2.6E-06	2.0E-03

Table C3a. Carcinogen screening indices for organic compounds using maximum concentrations and conservative estimates of exposure (Exposure pathways based on consumption of water and fish and the assumed use of water for irrigation)

Reach	Organic compound	Fish ingestion	Water ingestion	Meat ingestion	Milk ingestion	Vegetable ingestion	Soil ingestion	Dust inhalation	Multiple pathway total
R1									
1	PCB-1260 (AROCOLOR 1260)	7.5E-03	2.3E-06	8.3E-05	8.7E-05	3.5E-06	1.8E-07		7.7E-03
1	FLUORANTHENE	3.2E-03	5.1E-05	1.1E-05	1.2E-05	8.4E-05	4.0E-06		3.3E-03
1	PCB-1254 (AROCOLOR 1254)	3.1E-03	6.8E-06	1.9E-05	2.1E-05	1.1E-05	5.4E-07		3.1E-03
1	METHYLENE CHLORIDE	5.4E-07	1.5E-05	6.2E-09	6.5E-09	2.8E-04	1.2E-06		2.9E-04
1	CHLORDANE	5.9E-05	3.9E-05	1.3E-07	1.3E-07	1.5E-04	3.1E-06		2.5E-04
1	P,P'DDT	1.6E-05	1.9E-08	1.2E-07	1.3E-07	2.9E-08	1.5E-09		1.6E-05
1	BIS(2-ETHYLHEXYL) PHTHALATE	1.3E-05	2.3E-07	5.1E-08	5.3E-08	3.9E-07	1.9E-08		1.4E-05
1	P,PDDD	6.9E-06	1.5E-08	4.3E-08	4.5E-08	2.4E-08	1.2E-09		7.0E-06
1	Pathway total	1.4E-02	1.1E-04	1.1E-04	1.2E-04	5.2E-04	9.0E-06		1.5E-02
R2									
2	PCB-1260 (AROCOLOR 1260)	7.9E-03	7.3E-07	2.6E-05	2.8E-05	1.1E-06	5.8E-08		8.0E-03
2	PCB-1254 (AROCOLOR 1254)	4.4E-03	6.0E-06	1.7E-05	1.8E-05	9.3E-06	4.8E-07		4.5E-03
2	CHLORDANE	9.3E-05	6.1E-05	2.0E-07	2.1E-07	2.3E-04	4.8E-06		3.9E-04
2	P,P'DDT	8.7E-06	1.1E-08	6.7E-08	7.0E-08	1.6E-08	8.3E-10		8.9E-06
2	BIS(2-ETHYLHEXYL) PHTHALATE	2.7E-06	2.0E-07	4.4E-08	4.6E-08	3.3E-07	1.6E-08		3.3E-06
2	Pathway total	1.2E-02	6.8E-05	4.4E-05	4.6E-05	2.4E-04	5.4E-06		1.3E-02
R3									
3	PCB-1254 (AROCOLOR 1254)	1.3E-03	2.2E-03	6.4E-03	6.7E-03	3.5E-03	1.8E-04		2.0E-02
3	BETA BHC	5.1E-06	2.1E-03	4.3E-05	4.5E-05	4.5E-03	1.7E-04		6.9E-03
3	PCB-1260 (AROCOLOR 1260)	6.2E-03	2.0E-06	7.1E-05	7.5E-05	3.0E-06	1.6E-07		6.3E-03
3	VINYL CHLORIDE	3.3E-05	3.9E-04	2.2E-07	2.3E-07	5.7E-03	3.1E-05		6.1E-03
3	PHENANTHRENE	2.2E-03	4.7E-04	5.0E-05	5.3E-05	8.1E-04	3.7E-05		3.6E-03
3	PYRENE	2.2E-03	4.3E-04	9.1E-05	9.6E-05	7.1E-04	3.4E-05		3.6E-03
3	FLUORANTHENE	2.2E-03	3.3E-04	7.2E-05	7.6E-05	5.4E-04	2.6E-05		3.2E-03
3	ANTHRACENE	2.2E-03	1.1E-04	9.3E-06	9.8E-06	2.0E-04	9.0E-06		2.5E-03
3	CHRYSENE	2.2E-03	6.8E-06	1.5E-05	1.5E-05	1.1E-05	5.4E-07		2.3E-03
3	BENZO(A)ANTHRACENE	2.0E-03	9.2E-06	1.0E-05	1.1E-05	1.5E-05	7.3E-07		2.0E-03

Table C3a (continued)

Reach	Organic compound	Fish ingestion	Water	Meat	Milk	Vegetable	Soil	Dust	Multiple pathway total
R3 (continued)									
3 TRICHLOROETHYLENE	1.6E-07	8.0E-05	1.2E-07	1.3E-07	4.7E-04	6.4E-06			5.6E-04
3 METHYLENE CHLORIDE	5.4E-07	2.6E-05	1.1E-08	4.9E-04	2.0E-06				5.2E-04
3 TRANS-1,3-DICHLOROPROPENE	1.6E-05	4.4E-05	4.4E-08	4.7E-08	3.6E-04	3.5E-06			4.2E-04
3 TETRACHLOROETHYLENE	7.3E-07	7.0E-05	6.7E-07	7.1E-07	1.8E-04	5.5E-06			2.5E-04
3 CARBON TETRACHLORIDE	1.9E-06	3.5E-05	1.2E-07	1.3E-07	1.3E-04	2.8E-06			1.7E-04
3 CHLOROFORM	8.7E-08	4.4E-06	4.4E-09	4.7E-09	3.7E-05	3.5E-07			4.1E-05
3 BIS(2-ETHYLHEXYL) PHTHALATE	2.7E-06	1.0E-05	2.2E-06	2.3E-06	1.7E-05	8.1E-07			3.5E-05
3 Pathway total	2.1E-02	6.4E-03	6.8E-03	7.1E-03	1.8E-02	5.1E-04			5.9E-02
R4									
4 PYRENE	6.5E-02	1.1E-03	2.3E-04	2.4E-04	1.8E-03	8.5E-05			6.8E-02
4 ANTHRACENTE	3.6E-02	1.3E-03	1.0E-04	1.1E-04	2.2E-03	1.0E-04			4.0E-02
4 CHRYSENE	1.9E-02	5.2E-05	1.1E-04	1.2E-04	8.1E-05	4.1E-06			1.9E-02
4 PHENANTHRENE	1.5E-02	9.4E-04	1.0E-04	1.1E-04	1.6E-03	7.5E-05			1.8E-02
4 BENZO(A)ANTHACENE	1.5E-02	7.0E-05	7.7E-05	8.1E-05	1.1E-04	5.6E-06			1.5E-02
4 PCB-1260 (AROCLO 1260)	2.6E-03	4.6E-08	1.7E-06	1.7E-06	7.0E-08	3.6E-09			2.6E-03
4 PCB-1254 (AROCLO 1254)	2.4E-03	5.0E-07	1.4E 06	1.5E-06	7.7E-07	4.0E-08			2.4E-03
4 CHLORDANE	1.1E-04	7.2E-05	2.3E-07	2.5E-07	2.8E-04	5.7E-06			4.6E-04
4 BIS(2-ETHYLHEXYL) PHTHALATE	1.3E-06	2.1E-08	4.6E-09	4.8E-09	3.5E-08	1.7E-09			1.4E-06
4 Pathway total	1.6E-01	3.5E-03	6.2E-04	6.6E-04	6.1E-03	2.8E-04			1.7E-01
R5									
5 PCB-1260 (AROCLO 1260)	7.5E-03	4.6E-08	1.7E-06	1.7E-06	7.0E-08	3.6E-09			7.5E-03
5 PCB-1254 (AROCLO 1254)	3.7E-03	5.0E-07	1.4E-06	1.5E-06	7.7E-07	4.0E-08			3.7E-03
5 Pathway total	1.1E-02	5.4E-07	3.1E-06	3.2E-06	8.4E-07	4.3E-08			1.1E-02
R18									
18 PCB-1254 (AROCLO 1254)	1.1E-03	2.4E-06	7.0E-06	7.3E-06	3.8E-06	1.9E-07			1.1E-03
18 Pathway total	1.1E-03	2.4E-06	7.0E-06	7.3E-06	3.8E-06	1.9E-07			1.1E-03

Table C3b. Carcinogen screening indices for organic compounds using maximum concentrations and conservative estimates of exposure (Exposure pathways based on assumed dredging of sediment and its subsequent use as agricultural soil)

Reach	Organic compound	Vegetable ingestion	Sediment ingestion	Dust inhalation	Milk ingestion	Meat ingestion	Multiple pathway total
R1							
1	PCB-1254 (AROCLOR 1254)	1.6E-03	1.5E-05		3.1E-03	2.9E-03	7.7E-03
1	FLUORANTHENE	1.3E-03	9.7E-06		1.7E-04	1.6E-04	1.6E-03
1	P,P'DDT	9.2E-06	8.8E-08		4.0E-05	3.8E-05	8.7E-05
1	CHLORDANE	4.5E-05	7.7E-08		3.7E-08	3.5E-08	4.5E-05
1	P,P'DDD	9.6E-06	3.3E-08		6.7E-06	6.4E-06	1.7E-05
1	BIS (2-ETHYLHEXYL) PHTHALATE	5.7E-06	4.4E-08		7.5E-07	7.2E-07	7.2E-06
1	METHYLENE CHLORIDE	4.0E-06	1.1E-09		9.2E-11	8.8E-11	4.0E-06
1	Pathway total	3.0E-03	2.5E-05		3.3E-03	3.2E-03	9.4E-03
R2							
2	PCB-1260 (AROCLOR 1260)	1.8E-03	1.8E-05		4.5E-02	4.3E-02	9.0E-02
2	PCB-1254 (AROCLOR 1254)	1.4E-03	1.3E-05		2.7E-03	2.6E-03	6.7E-03
2	CHLORDANE	7.0E-05	1.2E-07		5.8E-08	5.5E-08	7.0E-05
2	P,P'DDT	5.2E-06	4.9E-08		2.2E-05	2.1E-05	4.9E-05
2	BIS (2-ETHYLHEXYL) PHTHALATE	4.9E-06	3.8E-08		6.5E-07	6.2E-07	6.3E-06
2	Pathway total	3.3E-03	3.1E-05		4.8E-02	4.6E-02	9.7E-02
R3							
3	PYRENE	1.0E-02	7.9E-05		1.3E-03	1.3E-03	1.3E-02
3	FLUORANTHENE	8.1E-03	6.9E-05		1.1E-03	1.0E-03	1.0E-02
3	BETA BHC	8.4E-03	3.7E-05		7.6E-05	7.2E-05	8.5E-03
3	PHENANTHRENE	6.5E-03	4.4E-05		4.0E-04	3.8E-04	7.3E-03
3	CHRYSENE	1.3E-03	1.2E-05		1.8E-03	1.7E-03	4.8E-03
3	BENZO(a)ANTHRACENE	9.2E-04	8.2E-06		6.6E-04	6.3E-04	2.2E-03
3	ANTHRACENE	1.3E-03	8.2E-06		5.8E-05	5.5E-05	1.4E-03
3	BIS (2-ETHYLHEXYL) PHTHALATE	2.5E-04	1.9E-06		3.3E-05	3.1E-05	3.2E-04
3	TETRACHLOROETHYLENE	1.6E-04	5.3E-07		6.0E-07	5.7E-07	1.7E-04
3	VINYL CHLORIDE	1.3E-04	4.7E-08		5.2E-09	4.9E-09	1.3E-04

Table C3b (Continued)

Reach	Organic compound	Vegetable ingestion	Sediment ingestion	Dust inhalation	Milk ingestion	Meat ingestion	Multiple pathway total
R3	(continued)						
3	TRICHLOROETHYLENE	5.6E-05	5.5E-08		1.5E-08	1.4E-08	5.6E-05
3	CARBON TETRACHLORIDE	4.3E-05	7.8E-08		4.0E-08	3.8E-08	4.3E-05
3	TRANS-1,3-DICHLOROPROPENE	2.3E-05	1.5E-08		2.9E-09	2.7E-09	2.3E-05
3	METHYLENE CHLORIDE	7.1E-06	1.9E-09		1.6E-10	1.5E-10	7.1E-06
3	CHLOROFORM	2.3E-06	1.5E-09		2.8E-10	2.7E-10	2.3E-06
3	Pathway total	3.7E-02	2.5E-04		5.5E-03	5.2E-03	4.8E-02
R4							
4	CHRYSENE	9.7E-03	8.9E-05		1.4E-02	1.3E-02	3.7E-02
4	PYRENE	2.6E-02	2.0E-04		3.3E-03	3.2E-03	3.2E-02
4	BENZO(A)ANTHRACENE	7.0E-03	6.2E-05		5.0E-03	4.8E-03	1.7E-02
4	ANTHRACENE	1.4E-02	9.2E-05		6.5E-04	6.2E-04	1.5E-02
4	PHENANTHRENE	1.3E-02	8.9E-05		7.9E-04	7.5E-04	1.5E-02
4	CHLORDANE	8.3E-05	1.4E-07		6.9E-08	6.5E-08	8.4E-05
4	BIS (2-ETHYLHEXYL) PHTHALATE	5.2E-07	4.0E-09		6.9E-08	6.5E-08	6.6E-07
4	Pathway total	7.0E-02	5.3E-04		2.4E-02	2.3E-02	1.2E-01
R18							
18	PCB-1254 (AROCLOL 1254)	5.8E-04	5.4E-06		1.1E-03	1.1E-03	2.7E-03
18	Pathway total	5.8E-04	5.4E-06		1.1E-03	1.1E-03	2.7E-03

Table C4a. Carcinogen screening indices for radionuclides using maximum concentrations and conservative estimates of exposure (Exposure pathways based on consumption of water and fish and the assumed use of water for irrigation)

Reach	Radionuclide	Fish ingestion	Water ingestion	Meat ingestion	Milk ingestion	Vegetable ingestion	Soil ingestion	Dust inhalation	External soil dep.	Multiple pathway total
R1										
1	Sr-90	3.1E-07	7.9E-06	3.4E-06	1.1E-05	2.8E-05	4.5E-07	4.7E-08		5.2E-05
1	Cs-137	3.2E-06	1.8E-06	6.1E-06	5.5E-06	3.1E-06	1.1E-07	7.8E-10	4.7E-06	2.5E-05
1	U-234	4.3E-07	5.8E-07	6.1E-07	1.2E-07	8.9E-07	4.6E-08	2.5E-07	1.1E-09	2.9E-06
1	U-238	2.5E-07	3.3E-07	3.5E-07	7.0E-08	5.1E-07	2.6E-08	1.4E-07	4.3E-08	1.7E-06
1	Th-232	1.7E-07	2.8E-07	2.9E-09	4.8E-10	4.2E-07	2.2E-08	1.5E-07	2.2E-11	1.0E-06
1	Sr-89	3.2E-07	2.7E-07	2.5E-08	8.4E-08	3.4E-07	1.7E-10	8.7E-12	4.0E-09	1.0E-06
1	U-235	1.1E-07	1.9E-07	2.0E-07	4.1E-08	3.0E-07	1.5E-08	8.2E-08	4.2E-08	9.9E-07
1	Co-60	1.6E-07	2.7E-08	9.5E-08	2.1E-08	4.3E-08	5.8E-10	5.4E-11	1.9E-07	5.4E-07
1	Tc-99	1.7E-08	4.3E-08	2.4E-08	8.0E-08	1.9E-07	3.4E-09	2.2E-10	5.5E-12	3.5E-07
1	Pu-238	8.1E-08	1.2E-10	1.2E-13	4.0E-15	1.8E-10	8.2E-12	1.1E-10	7.2E-14	8.1E-08
1	Pa-234	1.0E-08	5.0E-08	6.7E-13	2.2E-12	1.6E-09	1.7E-13	7.3E-16	5.8E-10	6.3E-08
1	Pu-239	2.1E-08	9.6E-10	1.0E-12	3.4E-14	1.5E-09	7.6E-11	1.0E-09	2.6E-13	2.4E-08
1	U-236	1.3E-10	6.6E-10	6.9E-10	1.4E-10	1.0E-09	5.2E-11	2.8E-10	5.7E-13	3.0E-09
Pathway total		5.1E-06	1.1E-05	1.1E-05	1.7E-05	9.4E-05	6.7E-07	6.7E-07	5.0E-06	8.5E-05
R2										
2	Sr-90	1.7E-05	8.4E-04	3.6E-04	1.2E-03	3.0E-03	4.8E-05	5.0E-06		5.5E-03
2	Cs-137	1.5E-04	2.2E-04	7.3E-04	6.5E-04	3.7E-04	1.3E-05	9.2E-08	5.6E-04	2.7E-03
2	H-3	3.5E-05	1.8E-03	1.8E-04	4.4E-04	1.8E-04				2.6E-03
2	Am-241	6.7E-05	1.1E-04	2.4E-07	1.6E-08	1.7E-04	8.7E-06	2.4E-05	4.5E-07	3.9E-04
2	Cm-244	6.1E-05	1.0E-04	2.1E-07	1.4E-08	1.5E-04	4.8E-06	1.4E-05	1.4E-08	3.3E-04
2	Co-60	7.2E-07	1.5E-05	5.2E-05	1.1E-05	2.4E-05	3.1E-07	2.9E-08	1.0E-04	2.0E-04
2	Pu-238	8.7E-08	3.1E-05	3.3E-08	1.1E-09	4.7E-05	2.2E-06	3.0E-05	1.9E-08	1.1E-04
2	Eu-154	3.0E-06	3.0E-06	6.4E-07	6.4E-08	4.6E-06	8.8E-08	3.0E-08	4.3E-05	5.4E-05
2	Eu-152	1.3E-06	1.3E-06	2.8E-07	2.8E-08	2.0E-06	5.1E-08	2.0E-08	3.3E-05	3.8E-05
2	Pu-239	6.6E-06	4.9E-06	5.1E-09	1.7E-10	7.4E-06	3.8E-07	5.2E-06	1.3E-09	2.4E-05
2	Cs-134	2.4E-06	6.0E-08	1.9E-07	1.7E-07	9.2E-08	5.3E-10	3.9E-12	4.4E-08	3.0E-06

Table C4a (continued)

Reach	Radionuclide	Fish ingestion	Water ingestion	Meat ingestion	Milk ingestion	Vegetable ingestion	Soil ingestion	Dust inhalation	External soil dep.	Multiple pathway total
R2 (continued)										
2	U-234	4.2E-07	4.1E-07	4.4E-07	8.7E-08	6.4E-07	3.3E-08	1.8E-07	7.9E-10	2.2E-06
2	U-238	2.5E-07	2.5E-07	2.7E-07	5.3E-08	3.9E-07	2.0E-08	1.1E-07	3.2E-08	1.4E-06
2	U-235	3.4E-08	1.9E-07	2.0E-07	4.1E-08	3.0E-07	1.5E-08	8.2E-08	4.2E-08	9.1E-07
2	Th-234	4.8E-09	8.0E-09	6.1E-11	1.0E-11	8.0E-09	2.3E-12	6.8E-14	6.5E-12	2.1E-08
2	Pa-234	3.3E-09	1.6E-08	2.2E-13	7.2E-13	5.1E-10	5.5E-14	2.4E-16	1.9E-10	2.0E-08
2	U-236	2.7E-10	1.4E-09	1.4E-09	2.9E-10	2.1E-09	1.1E-10	5.8E-10	1.2E-12	6.2E-09
	Pathway total	3.4E-04	3.1E-03	1.3E-03	2.3E-03	4.0E-03	7.7E-05	7.8E-05	7.4E-04	1.2E-02
R3										
3	U-238	6.1E-05	3.1E-04	3.2E-04	6.4E-05	4.7E-04	2.4E-05	1.3E-04	3.9E-05	1.4E-03
3	U-235	5.8E-06	2.9E-05	3.1E-05	6.1E-06	4.5E-05	2.3E-06	1.2E-05	6.3E-06	1.4E-04
3	Sr-90	5.9E-07	4.1E-06	1.8E-06	6.0E-06	1.5E-05	2.4E-07	2.5E-08		2.8E-05
3	Co-60	2.5E-06	4.2E-07	1.5E-06	3.2E-07	6.6E-07	8.9E-09	8.3E-10	2.9E-06	8.2E-06
3	Cs-137	6.1E-06	1.5E-07	5.2E-07	4.6E-07	2.6E-07	8.9E-09	6.5E-11	4.0E-07	7.9E-06
3	Tc-99	4.3E-08	1.1E-07	6.0E-08	2.0E-07	4.7E-07	8.4E-09	5.5E-10	1.4E-11	8.8E-07
3	Sr-89	1.6E-07	1.3E-07	1.3E-08	4.2E-08	1.7E-07	8.4E-11	4.3E-12	2.0E-09	5.2E-07
3	Cs-134	2.3E-07	5.7E-09	1.8E-08	1.6E-08	8.7E-09	5.0E-11	3.6E-13	4.1E-09	2.8E-07
3	Cm-244	4.0E-08	6.7E-08	1.4E-10	9.4E-12	1.0E-07	3.2E-09	9.0E-09	9.4E-12	2.2E-07
3	Pa-234	1.8E-08	8.8E-08	1.2E-12	3.9E-12	2.8E-09	2.9E-13	1.3E-15	1.0E-09	1.1E-07
3	Am-241	6.3E-09	1.1E-08	2.2E-11	1.5E-12	1.6E-08	8.2E-10	2.3E-09	4.3E-11	3.6E-08
3	Th-234	7.2E-09	1.2E-08	9.2E-11	1.5E-11	1.2E-08	3.5E-12	1.0E-13	9.7E-12	3.1E-08
3	Pu-239	2.1E-10	2.6E-09	2.7E-12	9.2E-14	4.0E-09	2.1E-10	2.8E-09	7.2E-13	9.9E-09
3	Pu-238	3.7E-11	4.6E-10	4.8E-13	1.6E-14	7.0E-10	3.3E-11	4.4E-10	2.9E-13	1.7E-09
3	Pa-233	1.3E-10	6.3E-10	2.5E-13	8.4E-13	6.6E-10	2.1E-13	6.2E-15	5.1E-11	1.5E-09
	Pathway total	7.7E-05	3.4E-04	3.6E-04	7.8E-05	5.3E-04	2.7E-05	1.4E-04	4.9E-05	1.6E-03

Table C4a (continued)

Reach	Radionuclide	Fish ingestion	Water ingestion	Meat ingestion	Milk ingestion	Vegetable ingestion	Soil ingestion	Dust inhalation	External soil dep.	Multiple pathway total
R4										
4	Sr-90	6.5E-06	8.9E-06	3.9E-06	1.3E-05	3.2E-05	5.1E-07	5.3E-08	6.4E-05	
4	Cs-137	2.4E-05	6.0E-07	2.0E-06	1.8E-06	1.0E-06	3.5E-08	2.6E-10	3.1E-05	
4	Sr-89	5.4E-08	2.7E-06	2.5E-07	8.4E-07	3.4E-06	1.7E-09	8.7E-11	4.0E-08	7.3E-06
4	Am-241	1.0E-06	1.7E-06	3.6E-09	2.4E-10	2.6E-06	1.3E-07	3.6E-07	6.9E-09	5.8E-06
4	Pu-239	1.1E-07	1.4E-06	1.5E-09	5.0E-11	2.2E-06	1.1E-07	1.5E-06	3.9E-10	5.4E-06
4	U-234	2.4E-06	4.1E-07	4.4E-07	8.7E-08	6.4E-07	3.3E-08	1.8E-07	7.9E-10	4.2E-06
4	Cm-244	4.6E-07	7.6E-07	1.6E-09	1.1E-10	1.2E-06	3.6E-08	1.0E-07	1.1E-10	2.5E-06
4	H-3	2.7E-08	1.4E-06	1.4E-07	3.4E-07	1.4E-07				2.0E-06
4	U-238	8.8E-07	2.3E-07	2.4E-07	4.8E-08	3.5E-07	1.8E-08	9.6E-08	2.9E-08	1.9E-06
4	U-235	6.6E-07	2.0E-07	2.1E-07	4.2E-08	3.1E-07	1.6E-08	8.4E-08	4.3E-08	1.6E-06
4	Tc-99	3.4E-08	8.5E-08	4.8E-08	1.6E-07	3.7E-07	6.8E-09	4.4E-10	1.1E-11	7.1E-07
4	Co-60	1.6E-07	2.6E-08	9.2E-08	2.0E-08	4.2E-08	5.6E-10	5.2E-11	1.8E-07	5.2E-07
4	Pu-238	1.0E-07	2.2E-08	2.3E-11	7.8E-13	3.4E-08	1.6E-09	2.1E-08	1.4E-11	1.8E-07
4	Th-234	4.8E-09	8.0E-09	6.1E-11	1.0E-11	8.0E-09	2.3E-12	6.8E-14	6.5E-12	2.1E-08
4	U-236	4.6E-10	2.3E-09	2.4E-09	4.9E-10	3.5E-09	1.8E-10	9.8E-10	2.0E-12	1.0E-08
Pathway total		3.6E-05	1.8E-05	7.3E-06	1.6E-05	4.4E-05	9.0E-07	2.4E-06	1.9E-06	1.3E-04
R5										
5	Sr-90	7.5E-05	6.2E-05	2.7E-05	9.0E-05	2.2E-04	3.5E-06	3.7E-07		4.8E-04
5	Cs-137	1.4E-04	3.4E-06	1.1E-05	1.0E-05	5.8E-06	2.0E-07	1.4E-09	8.8E-06	1.8E-04
5	Co-60	3.1E-07	5.2E-08	1.8E-07	4.1E-08	8.3E-08	1.1E-09	1.0E-10	3.6E-07	1.0E-06
5	Pu-239	1.6E-09	2.1E-08	2.1E-11	7.1E-13	3.1E-08	1.6E-09	2.2E-08	5.6E-12	7.7E-08
5	Pu-238	7.8E-11	9.8E-10	1.0E-12	3.4E-14	1.5E-09	6.9E-11	9.3E-10	6.1E-13	3.6E-09
Pathway total		2.1E-04	6.6E-05	3.9E-05	1.0E-04	2.3E-04	3.7E-06	4.0E-07	9.1E-06	6.6E-04

Table C4a (continued)

Reach	Radionuclide	Fish ingestion	Water ingestion	Meat ingestion	Milk ingestion	Vegetable ingestion	Soil ingestion	Dust inhalation	External soil dep.	Multiple pathway total
<hr/>										
R10										
10	Sr-90	1.0E-05	8.3E-06	3.6E-06	1.2E-05	3.0E-05	4.7E-07	5.0E-08		6.4E-05
10	Sr-89	6.5E-06	5.4E-06	5.1E-07	1.7E-06	6.8E-06	3.4E-09	1.7E-10	8.1E-08	2.1E-05
10	Cs-137	8.7E-07	2.2E-08	7.4E-08	6.6E-08	3.8E-08	1.3E-09	9.3E-12	5.7E-08	1.1E-06
10	Cm-244	2.5E-08	4.2E-08	8.8E-11	5.9E-12	6.4E-08	2.0E-09	5.6E-09	5.8E-12	1.4E-07
10	Am-241	2.5E-09	4.2E-09	8.7E-12	5.8E-13	6.4E-09	3.2E-10	8.9E-10	1.7E-11	1.4E-08
	Pathway total	1.8E-05	1.4E-05	4.2E-06	1.4E-05	3.7E-05	4.8E-07	5.6E-08	1.6E-07	8.7E-05
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R18										
18	Cs-137	3.9E-07	9.8E-09	3.1E-08	2.7E-08	1.5E-08	5.7E-10	4.2E-12	2.6E-08	5.0E-07
	Pathway total	3.9E-07	9.8E-09	3.1E-08	2.7E-08	1.5E-08	5.7E-10	4.2E-12	2.6E-08	5.0E-07

Table C4b. Carcinogen screening indices for radionuclides using maximum concentrations and conservative estimates of exposure (Exposure pathways based on assumed dredging of sediment and its subsequent use as agricultural soil)

Beach	Radionuclide	Vegetable ingestion	Sediment ingestion	Dust inhalation	Milk ingestion	Meat ingestion	External sediment	Multiple pathway total
R1	Pa-234	2.8E-07	1.3E-08	5.5E-11	2.9E-10	8.7E-11	7.3E-04	7.3E-04
1	Th-232	2.8E-04	2.8E-06	1.9E-05	3.2E-07	1.9E-06	4.5E-08	3.1E-04
1	Cs-137	1.5E-05	9.5E-08	7.0E-10	2.4E-05	2.7E-05	7.1E-05	1.4E-04
1	Co-60	1.3E-06	8.2E-09	7.7E-10	9.1E-07	4.1E-06	4.4E-05	5.1E-05
1	U-234	2.3E-05	2.2E-07	1.2E-06	3.2E-06	1.6E-05	9.0E-08	4.4E-05
1	U-238	1.4E-05	1.3E-07	6.9E-07	1.9E-06	9.3E-06	3.5E-06	2.9E-05
1	Sr-90	1.5E-05	2.1E-08	2.2E-09	7.1E-06	2.1E-06	5.9E-06	3.7E-06
1	U-235	8.6E-06	8.1E-08	4.3E-07	1.2E-06	2.7E-07	1.1E-06	2.0E-05
1	Sr-89	1.8E-06	2.7E-09	1.4E-10	9.2E-07	2.7E-07	1.1E-06	4.1E-06
1	Pu-239	9.8E-07	9.6E-09	1.3E-07	2.2E-11	6.7E-10	5.6E-10	1.1E-06
1	Pu-238	1.2E-07	1.2E-09	1.5E-08	2.7E-12	8.1E-11	1.7E-10	1.3E-07
1	U-236	6.9E-09	6.6E-11	3.5E-10	9.4E-10	4.7E-09	1.2E-11	1.3E-08
1	Tc-99	4.5E-09	6.4E-12	4.2E-13	2.2E-09	6.6E-10	1.7E-13	7.3E-09
	Pathway total	3.7E-04	3.4E-06	2.2E-05	3.9E-05	6.6E-05	8.5E-04	1.3E-03
R2	Cs-137	5.5E-01	3.4E-03	2.5E-05	8.5E-01	9.6E-01	2.5E+00	4.9E+00
2	Sr-90	1.2E-01	1.7E-04	1.7E-05	5.7E-02	1.7E-02	1.9E-01	1.1E-01
2	Co-60	2.8E-03	1.7E-05	1.6E-06	1.9E-03	8.5E-03	9.2E-02	2.5E-02
2	Am-241	2.4E-02	2.3E-04	6.5E-04	2.2E-06	3.3E-05	2.0E-04	5.2E-03
2	Pu-239	4.5E-03	4.4E-05	6.0E-04	1.0E-07	3.1E-06	2.6E-06	2.2E-03
2	Cm-244	2.1E-03	2.0E-05	5.7E-05	1.9E-07	2.9E-06	9.8E-07	2.0E-03
2	U-238	9.6E-04	9.1E-06	4.9E-05	1.3E-04	6.5E-04	2.4E-04	1.6E-03
2	Eu-154	2.0E-05	1.9E-07	6.7E-08	3.2E-07	3.2E-06	9.2E-04	9.3E-04
2	Eu-152	8.8E-06	8.4E-08	3.3E-08	1.4E-07	1.4E-06	2.5E-04	3.7E-04
2	Cs-134	2.9E-05	1.8E-07	1.3E-09	4.5E-05	5.1E-05	3.5E-07	2.8E-04
2	Pu-238	2.4E-04	2.4E-06	3.2E-05	5.5E-09	1.7E-07	1.7E-08	2.4E-04
2	Pa-234	9.0E-08	4.1E-09	1.8E-11	9.4E-11	2.8E-11	2.0E-04	2.0E-04
2	U-235	8.6E-05	8.1E-07	4.3E-06	1.2E-05	5.9E-05	3.7E-05	9.3E-06
2	Th-234	5.4E-06	8.0E-08	2.3E-09	6.9E-09	4.1E-08	3.7E-06	8.2E-06
2	U-234	4.3E-06	4.1E-08	2.2E-07	5.9E-07	3.0E-06	1.7E-08	2.7E-08
2	U-236	1.4E-08	1.4E-10	7.4E-10	2.0E-09	9.9E-09	2.5E-11	5.2E+00
	Pathway total	7.0E-01	3.9E-03	1.4E-03	9.1E-01	9.8E-01	2.6E+00	

Table C4b (continued)

Reach	Radionuclide	Vegetable ingestion	Sediment ingestion	Dust inhalation	Milk ingestion	Meat ingestion	External sediment	Multiple pathway total
R3	Co-60	2.0E-04	1.3E-06	1.2E-07	1.4E-04	6.2E-04	6.7E-03	7.7E-03
	U-238	3.2E-03	3.1E-05	1.6E-04	4.4E-04	2.2E-03	8.2E-04	6.9E-03
	Pa-234	4.9E-07	2.2E-08	9.5E-11	5.1E-10	1.5E-10	1.3E-03	1.3E-03
	U-235	3.1E-04	2.9E-06	1.5E-05	4.2E-05	2.1E-04	1.3E-04	7.1E-04
	Cs-137	7.4E-05	4.6E-07	3.4E-09	1.1E-04	1.3E-04	3.4E-04	6.6E-04
	Sr-90	2.9E-05	4.1E-08	4.4E-09	1.4E-05	4.3E-06	4.3E-05	4.8E-05
	Cs-134	2.7E-06	1.7E-08	1.2E-10	4.2E-06	4.8E-06	2.3E-05	3.5E-05
	Th-234	8.1E-06	1.2E-07	3.5E-09	1.0E-08	6.2E-08	5.6E-06	1.4E-05
	Am-241	1.1E-05	1.1E-07	2.9E-07	9.9E-10	1.5E-08	9.2E-08	1.1E-05
	Pu-239	2.7E-06	2.6E-08	3.6E-07	6.1E-11	1.8E-09	1.5E-09	3.1E-06
R4	Sr-89	9.2E-07	1.3E-09	6.9E-11	4.6E-07	1.4E-07	5.4E-07	2.1E-06
	Cm-244	1.4E-06	1.3E-08	3.8E-08	1.3E-10	1.9E-09	6.5E-10	1.4E-06
	Pa-233	1.4E-08	1.6E-10	4.8E-12	1.7E-11	5.2E-12	6.5E-07	6.7E-07
	Pu-238	4.7E-07	4.6E-09	6.2E-08	1.1E-11	3.2E-10	6.8E-10	5.4E-07
	Tc-99	1.1E-08	1.6E-11	1.0E-12	5.5E-09	1.6E-09	4.3E-13	1.8E-08
	Pathway total	3.9E-03	3.6E-05	1.8E-04	7.5E-04	3.2E-03	9.3E-03	1.7E-02
	Cs-137	3.8E-03	2.3E-05	1.7E-07	5.8E-03	6.6E-03	1.7E-02	3.4E-02
	U-238	3.7E-03	3.6E-05	1.9E-04	5.1E-04	2.6E-03	9.6E-04	8.0E-03
	Sr-90	1.7E-03	2.4E-06	2.5E-07	8.3E-04	2.5E-04	2.3E-07	2.8E-03
	Co-60	5.0E-05	3.1E-07	2.9E-08	3.4E-05	1.5E-04	1.7E-03	1.9E-03
R5	Am-241	1.8E-03	1.7E-05	4.7E-05	1.6E-07	2.4E-06	1.5E-05	1.8E-03
	U-235	1.9E-04	1.8E-06	9.5E-06	2.6E-05	1.3E-04	8.1E-05	4.3E-04
	Pu-239	3.3E-04	3.3E-06	4.4E-05	7.6E-09	2.3E-07	1.9E-07	3.8E-04
	Sr-89	1.8E-05	2.7E-08	1.4E-09	9.2E-06	2.7E-06	1.1E-05	4.1E-05
	Pu-238	2.3E-05	2.2E-07	3.0E-06	5.2E-10	1.6E-08	3.3E-08	2.6E-05
	Cm-244	1.6E-05	1.5E-07	4.2E-07	1.4E-09	2.1E-08	7.3E-09	1.6E-05
	Th-234	5.4E-06	8.0E-08	2.3E-09	6.9E-09	4.1E-08	3.7E-06	9.3E-06
	U-234	4.3E-06	4.1E-08	2.2E-07	5.9E-07	3.0E-06	1.7E-08	8.2E-06
	U-236	2.4E-08	2.3E-10	1.2E-09	3.3E-09	1.7E-08	4.2E-11	4.6E-08
	Tc-99	9.0E-09	1.3E-11	8.4E-13	4.4E-09	1.3E-09	3.5E-13	1.5E-08
Pathway total		1.2E-02	8.4E-05	3.0E-04	7.3E-03	9.7E-03	2.0E-02	4.9E-02

Table C4b (continued)

Reach	Radionuclide	Vegetable ingestion	Sediment ingestion	Dust inhalation	Milk ingestion	Meat ingestion	External sediment	Multiple pathway total
R5	Cs-137	1.6E-03	1.0E-05	7.5E-08	2.5E-03	2.8E-03	7.6E-03	1.5E-02
	Co-60	2.5E-05	1.6E-07	1.5E-08	1.7E-05	7.8E-05	8.4E-04	9.6E-04
	Sr-90	4.4E-04	6.2E-07	6.5E-08	2.1E-04	6.4E-05		7.1E-04
	Pu-239	2.1E-05	2.1E-07	2.8E-06	4.8E-10	1.4E-08	1.2E-08	2.4E-05
	Pu-238	1.0E-06	9.8E-09	1.3E-07	2.3E-11	6.8E-10	1.4E-09	1.1E-06
	Pathway total	2.1E-03	1.1E-05	3.1E-06	2.8E-03	3.0E-03	8.4E-03	1.6E-02
R10	Sr-90	5.8E-05	8.3E-08	8.7E-09	2.8E-05	8.5E-06		9.5E-05
	Cs-137	1.1E-05	6.5E-08	4.8E-10	1.6E-05	1.8E-05	4.9E-05	9.4E-05
	Sr-89	3.7E-05	5.4E-08	2.8E-09	1.8E-05	5.5E-06	2.2E-05	8.2E-05
	Am-241	4.3E-06	4.2E-08	1.2E-07	3.9E-10	5.9E-09	3.6E-08	4.5E-06
	Cm-244	8.7E-07	8.4E-09	2.4E-08	7.9E-11	1.2E-09	4.1E-10	9.0E-07
	Pathway total	1.2E-04	3.1E-07	1.5E-07	7.8E-05	4.9E-05	1.1E-04	3.6E-04
R18	Cs-137	4.8E-06	3.0E-08	2.2E-10	7.4E-06	8.3E-06	2.2E-05	4.2E-05
	Pathway total	4.8E-06	3.0E-08	2.2E-10	7.4E-06	8.3E-06	2.2E-05	4.2E-05

Table C5a. Summation screening indices for noncarcinogens by pathway and contaminant type
 (Exposure pathways based on consumption of water and fish and
 the assumed use of water for irrigation)

Reach	Contaminant type	Fish ingestion	Water ingestion	Meat ingestion	Milk ingestion	Vegetable ingestion	Soil ingestion	Dust inhalation	Multiple pathway total
R1	Inorganics	1.7E+01	5.9E+00	3.6E+00	1.3E+00	1.0E+01	4.7E-01	4.2E-04	3.8E+01
R1	Organics	9.0E-01	5.3E-01	2.5E-03	2.6E-03	2.5E+00	4.2E-02	4.0E+00	4.0E+00
R1	Pathway total	1.8E+01	6.4E+00	3.6E+00	1.3E+00	1.3E+01	5.1E-01	4.2E-04	4.2E+01
R2	Inorganics	5.6E+00	1.4E+01	2.3E+00	9.0E-01	2.2E+01	1.1E+00	1.4E-04	4.5E+01
R2	Organics	1.3E+00	7.8E-01	3.1E-03	3.2E-03	3.0E+00	6.2E-02	5.1E+00	5.1E+00
R2	Pathway total	6.9E+00	1.5E+01	2.3E+00	9.1E-01	2.5E+01	1.2E+00	1.4E-04	5.0E+01
R3	Inorganics	1.2E+01	3.8E+01	3.0E+01	1.4E+01	8.2E+01	3.0E+00	3.3E-05	1.8E+02
R3	Organics	3.4E-01	1.6E+00	1.2E-02	1.2E-02	1.1E+01	1.3E-01		1.4E+01
R3	Pathway total	1.2E+01	3.9E+01	3.0E+01	1.4E+01	9.3E+01	3.1E+00	3.3E-05	1.9E+02
R4	Inorganics	3.0E+00	7.1E+00	5.2E+00	1.6E+01	5.8E+01	5.6E-01	2.5E-04	9.0E+01
R4	Organics	1.4E+00	9.3E-01	3.0E-03	3.2E-03	3.5E+00	7.4E-02		6.0E+00
R4	Pathway total	4.5E+00	8.1E+00	5.2E+00	1.6E+01	6.2E+01	6.4E-01	2.5E-04	9.6E+01
R5	Inorganics	3.2E-01	6.4E-02	6.2E-02	2.4E-02	1.6E-01	5.1E-03	1.0E-06	6.3E-01
R5	Pathway total	3.2E-01	6.4E-02	6.2E-02	2.4E-02	1.6E-01	5.1E-03	1.0E-06	6.3E-01
R10	Inorganics	3.3E-01	7.7E-02	3.7E-02	1.5E-02	1.3E-01	6.1E-03		5.9E-01
R10	Pathway total	3.3E-01	7.7E-02	3.7E-02	1.5E-02	1.3E-01	6.1E-03		5.9E-01
R13	Inorganics	1.9E+00	2.8E-01	1.7E-01	7.6E-02	4.9E-01	2.2E-02		2.9E+00
R13	Pathway total	1.9E+00	2.8E-01	1.7E-01	7.6E-02	4.9E-01	2.2E-02		2.9E+00
R18	Inorganics	5.7E-01	4.6E-02	8.9E-02	1.8E-02	1.4E-01	3.6E-03		8.6E-01
R18	Pathway total	5.7E-01	4.6E-02	8.9E-02	1.8E-02	1.4E-01	3.6E-03		8.6E-01

Table C5b. Summation screening indices for noncarcinogens by pathway and contaminant type (Exposure pathways based on assumed dredging of sediment and its subsequent use as agricultural soil)

Reach	Contaminant type	Vegetable ingestion	Sediment ingestion	Dust inhalation	Milk ingestion	Meat ingestion	Multiple pathway total
R1	Inorganics	4.6E-01	1.2E-01	3.3E-05	1.9E+01	4.1E+01	1.1E+02
R1	Organics	6.6E-01	1.7E-03		2.4E-01	2.3E-01	1.1E+00
R1	Pathway total	4.6E+01	1.2E-01	3.3E-05	1.9E+01	4.1E+01	1.1E+02
R2	Inorganics	4.9E-01	2.0E-01	1.8E-03	4.9E+01	1.3E+02	2.3E+02
R2	Organics	9.5E-01	2.0E-03		1.3E-01	1.3E-01	1.2E+00
R2	Pathway total	5.0E+01	2.0E-01	1.8E-03	4.9E+01	1.3E+02	2.3E+02
R3	Inorganics	1.2E+02	5.9E-01	2.6E-03	6.9E+01	2.0E+02	3.9E+02
R3	Organics	2.2E+00	9.2E-03		1.2E-01	1.1E-01	2.5E+00
R3	Pathway total	1.3E+02	6.0E-01	2.6E-03	6.9E+01	2.0E+02	4.0E+02
R4	Inorganics	2.1E+02	4.1E-01	3.1E-03	7.7E+01	2.5E+02	5.4E+02
R4	Organics	1.1E+00	1.9E-03		1.1E-03	1.1E-03	1.1E+00
R4	Pathway total	2.1E+02	4.1E-01	3.1E-03	7.7E+01	2.5E+02	5.4E+02
R5	Inorganics	8.8E+01	1.6E-01	1.3E-05	8.8E+00	4.5E+01	1.4E+02
R5	Pathway total	8.8E+01	1.6E-01	1.3E-05	8.8E+00	4.5E+01	1.4E+02
R10	Inorganics	5.3E+00	4.5E-02		4.8E-01	1.9E+00	7.7E+00
R10	Pathway total	5.3E+00	4.5E-02		4.8E-01	1.9E+00	7.7E+00
R13	Inorganics	2.2E+01	2.1E-01		9.5E-01	2.4E+00	2.6E+01
R13	Pathway total	2.2E+01	2.1E-01		9.5E-01	2.4E+00	2.6E+01
R18	Inorganics	1.5E+02	2.5E-01		1.2E+01	7.2E+01	2.4E+02
R18	Pathway total	1.5E+02	2.5E-01		1.2E+01	7.2E+01	2.4E+02

Table C6a. Noncarcinogen screening indices for inorganic compounds using maximum concentrations and conservative estimates of exposure (Exposure pathways based on consumption of water and fish and the assumed use of water for irrigation)

Reach	Inorganic contaminant	Fish ingestion	Water ingestion	Meat ingestion	Milk ingestion	Vegetable ingestion	Soil ingestion	Dust inhalation	Multiple pathway total
R1	THALLIUM	1.6E+01	7.8E-02	2.7E-01	1.3E-01	2.7E-01	6.2E-03		1.6E+01
1	ARSENIC	1.2E-01	5.1E+00	1.1E-02	7.2E-04	7.9E+00	4.1E-01		1.4E+01
1	SELENIUM	1.7E-01	1.5E-01	2.5E+00	8.2E-01	3.8E-01	1.2E-02	4.2E-04	4.0E+00
1	MERCURY, TOTAL	4.2E-01	2.5E-01	5.4E-01	9.0E-02	1.1E+00	2.0E-02		2.4E+00
1	ANTIMONY	7.1E-01	1.1E-01	1.2E-02	3.9E-03	1.7E-01	8.5E-03		1.0E+00
1	CHROMIUM	2.1E-02	6.0E-02	2.0E-01	4.4E-02	9.7E-02	4.8E-03		4.2E-01
1	SILVER	6.7E-02	2.4E-02	2.6E-02	1.7E-01	8.2E-02	1.9E-03		3.7E-01
1	CADMIUM	4.0E-02	1.0E-02	2.2E-03	1.5E-02	6.3E-02	7.9E-04		1.3E-01
1	URANIUM	5.6E-03	2.8E-02	3.0E-02	5.9E-03	4.3E-02	2.2E-03		1.1E-01
1	ZINC	1.6E-02	2.0E-03	4.4E-02	1.5E-02	1.1E-02	1.6E-04		8.7E-02
1	NICKEL	1.4E-02	1.4E-02	3.6E-03	6.1E-03	2.9E-02	1.1E-03		6.8E-02
1	CYANIDE	5.7E-05	2.9E-03	6.0E-05	1.0E-04	4.4E-03	2.3E-04		7.7E-03
1	BERYLLIUM	3.4E-03	4.6E-04	2.4E-04	3.3E-07	7.1E-04	3.6E-05		4.9E-03
1	Pathway total	1.7E+01	5.9E+00	3.6E+00	1.3E+00	1.0E+01	4.7E-01	4.2E-04	3.8E+01
R2	ARSENIC	1.1E-01	1.3E+01	2.7E-02	1.8E-03	2.0E+01	1.0E+00		3.4E+01
2	THALLIUM	4.1E+00	2.0E-02	7.1E-02	3.5E-02	7.0E-02	1.6E-03		4.3E+00
2	CHROMIUM	2.1E-02	2.7E-01	8.7E-01	1.9E-01	4.3E-01	2.1E-02		1.8E+00
2	ANTIMONY	7.1E-01	3.6E-01	3.9E-02	1.3E-02	5.8E-01	2.8E-02		1.7E+00
2	SELENIUM	3.9E-02	5.2E-02	8.5E-01	2.8E-01	1.3E-01	4.2E-03	1.4E-04	1.4E+00
2	MERCURY, TOTAL	5.3E-01	1.9E-02	4.2E-02	6.9E-03	8.3E-02	1.5E-03		6.9E-01
2	ZINC	1.6E-02	1.3E-02	2.8E-01	9.4E-02	6.8E-02	1.0E-03		4.7E-01
2	CADMIUM	1.1E-02	4.3E-02	9.4E-03	6.2E-02	2.7E-01	3.4E-03		4.0E-01
2	SILVER	4.8E-02	2.4E-02	2.6E-02	1.7E-01	8.2E-02	1.9E-03		3.5E-01
2	URANIUM	1.7E-02	8.6E-02	9.0E-02	1.8E-02	1.3E-01	6.8E-03		3.5E-01

Table C6a (continued)

Reach	Inorganic contaminant	Fish ingestion	Water ingestion	Meat ingestion	Milk ingestion	Vegetable ingestion	Soil ingestion	Dust inhalation	Multiple pathway total
R2 (continued)									
2	NICKEL	1.4E-02	5.5E-02	1.4E-02	2.3E-02	1.1E-01	4.4E-03		2.2E-01
2	CYANIDE	3.7E-04	1.9E-02	3.9E-04	6.5E-04	2.8E-02	1.5E-03		5.0E-02
2	BERYLLIUM	2.3E-03	1.1E-03	6.1E-04	8.1E-07	1.8E-03	9.1E-05		5.9E-03
2	Pathway total	5.6E+00	1.4E+01	2.3E+00	9.0E-01	2.2E+01	1.1E+00	1.4E-04	4.5E+01
R3									
3	URANIUM	4.7E+00	2.4E+01	2.5E+01	5.0E+00	3.6E+01	1.9E+00		9.6E+01
3	BORON	1.9E-01	1.9E+00	8.6E-01	5.3E+00	2.1E+01	1.5E-01		2.9E+01
3	ANTIMONY	7.1E-01	9.6E+00	1.1E+00	3.5E-01	1.6E+01	7.6E-01		2.8E+01
3	CADMIUM	5.7E-03	7.1E-01	1.6E-01	1.0E+00	4.5E+00	5.7E-02		6.5E+00
3	NICKEL	2.9E-02	1.1E+00	2.9E-01	4.8E-01	2.3E+00	9.1E-02		4.3E+00
3	THALLIUM	4.1E+00	2.0E-02	7.1E-02	3.5E-02	7.0E-02	1.6E-03		4.3E+00
3	ZINC	2.3E-02	7.1E-02	1.6E+00	5.2E-01	3.8E-01	5.7E-03		2.6E+00
3	MERCURY, TOTAL	1.6E+00	4.8E-02	1.0E-01	1.7E-02	2.1E-01	3.8E-03		2.0E+00
3	SILVER	5.7E-02	1.2E-01	1.4E-01	9.0E-01	4.2E-01	9.8E-03		1.7E+00
3	ARSENIC	1.7E-01	3.0E-01	6.3E-04	4.2E-05	4.6E-01	2.4E-02		9.5E-01
3	CHROMIUM	3.4E-02	1.2E-01	3.8E-01	8.5E-02	1.9E-01	9.3E-03		8.2E-01
3	CYANIDE	2.8E-03	1.4E-01	3.0E-03	4.9E-03	2.2E-01	1.1E-02		3.8E-01
3	SELENIUM	4.8E-02	1.2E-02	1.9E-01	6.4E-02	2.9E-02	9.4E-04	3.3E-05	3.5E-01
3	BERYLLIUM	2.3E-03	6.9E-03	3.7E-03	4.9E-06	1.1E-02	5.4E-04		2.4E-02
3	TIN	4.3E-03	7.1E-04	1.6E-03	5.2E-04	3.1E-03	5.7E-05		1.0E-02
3	Pathway total	1.2E+01	3.8E+01	3.0E+01	1.4E+01	8.2E+01	3.0E+00	3.3E-05	1.3E+02

Table C6a (continued)

Reach	Inorganic contaminant	Fish ingestion	Water ingestion	Meat ingestion	Milk ingestion	Vegetable ingestion	Soil ingestion	Dust inhalation	Multiple pathway total
R4									
4	BORON	4.9E-01	4.9E+00	2.2E+00	1.4E+01	5.4E+01	3.9E-01		7.6E+01
4	BARIUM	1.1E-01	1.3E+00	3.1E-02	2.1E-01	2.2E+00	1.1E-01		4.0E+00
4	SELENIUM	2.5E-01	9.0E-02	1.5E+00	4.9E-01	2.2E-01	7.2E-03	2.5E-04	2.5E+00
4	VANADIUM	8.1E-01	2.0E-01	2.1E-01	3.6E-02	3.1E-01	1.6E-02		1.6E+00
4	CHROMIUM	4.7E-02	2.2E-01	7.2E-01	1.6E-01	3.6E-01	1.7E-02		1.5E+00
4	MERCURY, TOTAL	1.1E+00	2.9E-02	6.2E-02	1.0E-02	1.3E-01	2.3E-03		1.4E+00
4	SILVER	1.8E-02	8.8E-02	9.6E-02	6.4E-01	3.0E-01	7.0E-03		1.2E+00
4	ZINC	2.4E-02	1.7E-02	3.7E-01	1.2E-01	9.1E-02	1.4E-03		6.3E-01
4	CADMIUM	5.7E-03	4.3E-02	9.4E-03	6.2E-02	2.7E-01	3.4E-03		3.9E-01
4	ARSENIC	1.1E-01	7.7E-02	1.6E-04	1.1E-05	1.2E-01	6.1E-03		3.2E-01
4	NICKEL	1.4E-02	5.3E-02	1.3E-02	2.2E-02	1.1E-01	4.2E-03		2.1E-01
4	URANIUM	7.4E-03	3.7E-02	3.9E-02	7.9E-03	5.7E-02	3.0E-03		1.5E-01
4	BERYLLIUM	1.5E-03	7.7E-04	4.1E-04	5.4E-07	1.2E-03	6.1E-05		4.0E-03
4	Pathway total	3.0E+00	7.1E+00	5.2E+00	1.6E+01	5.8E+01	5.6E-01	2.5E-04	9.0E+01
R5									
5	MERCURY, TOTAL	1.7E-01	1.2E-02	2.5E-02	4.2E-03	5.1E-02	9.2E-04		2.6E-01
5	ARSENIC	5.7E-02	2.3E-02	4.8E-05	3.2E-06	3.5E-02	1.8E-03		1.2E-01
5	CHROMIUM	5.6E-02	7.7E-03	2.5E-02	5.6E-03	1.2E-02	6.1E-04		1.1E-01
5	NICKEL	1.4E-02	1.7E-02	4.4E-03	7.3E-03	3.4E-02	1.4E-03		7.9E-02
5	CADMIUM	1.4E-02	3.6E-03	7.8E-04	5.2E-03	2.2E-02	2.8E-04		4.7E-02
5	SELENIUM	1.5E-03	3.8E-04	6.2E-03	2.1E-03	9.4E-04	3.0E-05	1.0E-06	1.1E-02
5	BERYLLIUM	9.1E-04	4.6E-04	2.4E-04	3.3E-07	7.1E-04	3.6E-05		2.4E-03
5	Pathway total	3.2E-01	6.4E-02	6.2E-02	2.4E-02	1.6E-01	5.1E-03	1.0E-06	6.3E-01

Table C6a (continued)

Reach	Inorganic contaminant	Fish ingestion	Water ingestion	Meat ingestion	Milk ingestion	Vegetable ingestion	Soil ingestion	Dust inhalation	Multiple pathway total
R10	ARSENIC	2.7E-01	3.4E-02	7.2E-05	4.8E-06	5.2E-02	2.7E-03		3.6E-01
10	NICKEL	3.9E-02	1.9E-02	4.9E-03	8.2E-03	3.8E-02	1.5E-03		1.1E-01
10	URANIUM	4.1E-03	2.0E-02	2.2E-02	4.3E-03	3.2E-02	1.6E-03		8.4E-02
10	CHROMIUM	1.3E-02	3.3E-03	1.1E-02	2.4E-03	5.3E-03	2.6E-04		3.5E-02
10	MERCURY, TOTAL	9.5E-04	4.8E-05	1.0E-04	1.7E-05	2.1E-04	3.8E-06		1.3E-03
10	Pathway total	3.3E-01	7.7E-02	3.7E-02	1.5E-02	1.3E-01	6.1E-03		5.9E-01
R13	ARSENIC	1.6E+00	2.0E-01	4.2E-04	2.8E-05	3.1E-01	1.6E-02		2.1E+00
13	ZINC	1.4E-01	7.1E-03	1.6E-01	5.2E-02	3.8E-02	5.7E-04		4.0E-01
13	NICKEL	1.1E-01	5.4E-02	1.4E-02	2.3E-02	1.1E-01	4.3E-03		3.1E-01
13	CYANIDE	4.3E-04	2.1E-02	4.5E-04	7.5E-04	3.3E-02	1.7E-03		5.8E-02
13	Pathway total	1.9E+00	2.8E-01	1.7E-01	7.6E-02	4.9E-01	2.2E-02		2.9E+00
R18	MERCURY, TOTAL	4.3E-01	2.1E-02	4.7E-02	7.8E-03	9.4E-02	1.7E-03		6.0E-01
18	CHROMIUM	5.1E-02	1.3E-02	4.2E-02	9.3E-03	2.1E-02	1.0E-03		1.4E-01
18	ARSENIC	8.6E-02	1.1E-02	2.2E-05	1.5E-06	1.6E-02	8.5E-04		1.1E-01
18	CADMIUM	2.9E-03	7.1E-04	1.6E-04	1.0E-03	4.5E-03	5.7E-05		9.3E-03
18	Pathway total	5.7E-01	4.6E-02	8.9E-02	1.8E-02	1.4E-01	3.6E-03		8.6E-01

Table C6b. Noncarcinogen screening indices for inorganic compounds using maximum concentrations and conservative estimates of exposure (Exposure pathways based on assumed dredging of sediment and its subsequent use as agricultural soil)

Reach	Inorganic contaminant	Vegetable ingestion	Sediment ingestion	Dust inhalation	Milk ingestion	Meat ingestion	Multiple pathway total
R1							
1	THALLIUM	3.9E+01	7.8E-02		1.7E+01	3.3E+01	8.9E+01
1	ZINC	9.7E-01	1.1E-03		1.1E+00	3.3E+00	5.4E+00
1	CHROMIUM	9.4E-01	7.7E-03		4.1E-01	1.8E+00	3.2E+00
1	SELENIUM	2.9E-01	9.5E-04	3.3E-05	6.0E-01	1.8E+00	2.7E+00
1	ARSENIC	2.5E+00	2.4E-02		2.3E-04	3.4E-03	2.5E+00
1	CADMIUM	7.9E-01	7.1E-04		1.5E-01	2.2E-02	9.6E-01
1	NICKEL	5.2E-01	2.6E-03		1.0E-01	6.0E-02	6.8E-01
1	URANIUM	3.0E-01	2.8E-03		4.0E-02	2.0E-01	5.4E-01
1	MERCURY, TOTAL	3.3E-01	4.8E-04		2.5E-02	1.5E-01	5.1E-01
1	ANTIMONY	1.3E-01	1.1E-03		2.9E-03	8.7E-03	1.4E-01
1	BERYLLIUM	5.0E-02	4.6E-04		2.3E-05	1.7E-02	6.7E-02
1	CYANIDE	3.0E-03	2.9E-05		6.7E-05	4.0E-05	3.1E-03
1	Pathway total	4.6E+01	1.2E-01	3.3E-05	1.9E+01	4.1E+01	1.1E+02
R2							
2	SELENIUM	1.6E+01	5.2E-02	1.8E-03	3.3E+01	9.9E+01	1.5E+02
2	CHROMIUM	1.0E+01	8.3E-02		4.4E+00	2.0E+01	3.4E+01
2	THALLIUM	1.0E+01	2.0E-02		4.4E+00	8.7E+00	2.3E+01
2	SILVER	2.4E+00	4.8E-03		4.9E+00	7.4E-01	8.0E+00
2	CADMIUM	6.6E+00	6.0E-03		1.2E+00	1.9E-01	8.0E+00
2	ZINC	5.9E-01	6.6E-04		6.8E-01	2.0E+00	3.3E+00
2	ARSENIC	1.8E+00	1.7E-02		1.6E-04	2.4E-03	1.8E+00
2	URANIUM	9.0E-01	8.6E-03		1.2E-01	6.2E-01	1.7E+00
2	NICKEL	4.3E-01	2.1E-03		8.4E-02	5.0E-02	5.7E-01
2	ANTIMONY	4.3E-01	3.6E-03		9.7E-03	2.9E-02	4.8E-01
2	BERYLLIUM	1.2E-01	1.1E-03		5.7E-05	4.3E-02	1.7E-01
2	Pathway total	4.9E+01	2.0E-01	1.8E-03	4.9E+01	1.3E+02	2.3E+02

Table C6b (continued)

Reach	Inorganic contaminant	Vegetable ingestion	Sediment ingestion	Dust inhalation	Milk ingestion	Meat ingestion	Multiple pathway total
R3							
3	SELENIUM	2.3E+01	7.6E-02	2.6E-03	4.8E+01	1.4E+02	2.2E+02
3	CHROMIUM	9.4E+00	7.7E-02		4.1E+00	1.8E+01	3.2E+01
3	MERCURY, TOTAL	2.0E+01	2.8E-02		1.4E+00	8.7E+00	3.0E+01
3	NICKEL	1.9E+01	9.3E-02		3.6E+00	2.2E+00	2.5E+01
3	THALLIUM	1.0E+01	2.0E-02		4.4E+00	8.7E+00	2.3E+01
3	URANIUM	9.0E+00	8.5E-02		1.2E+00	6.1E+00	1.6E+01
3	ZINC	2.4E+00	2.6E-03		2.7E+00	8.2E+00	1.3E+01
3	ANTIMONY	1.2E+01	9.6E-02		2.6E-01	7.9E-01	1.3E+01
3	ARSENIC	1.0E+01	9.7E-02		9.1E-04	1.4E-02	1.0E+01
3	CADMIUM	5.5E+00	5.0E-03		1.0E+00	1.5E-01	6.7E+00
3	BORON	4.0E+00	1.9E-03		9.8E-01	1.6E-01	5.1E+00
3	SILVER	4.8E-01	9.5E-04		9.8E-01	1.5E-01	1.6E+00
3	BERYLLIUM	7.5E-01	6.9E-03		3.4E-04	2.6E-01	1.0E+00
3	TIN	5.0E-02	7.1E-05		7.4E-03	2.2E-02	8.0E-02
3	Pathway total	1.2E+02	5.9E-01	2.6E-03	6.9E+01	2.0E+02	3.9E+02
R4							
4	SELENIUM	2.7E+01	9.0E-02	3.1E-03	5.7E+01	1.7E+02	2.6E+02
4	MERCURY, TOTAL	1.6E+02	2.2E-01		1.2E+01	6.9E+01	2.4E+02
4	BORON	1.0E+01	4.9E-03		2.5E+00	4.1E-01	1.3E+01
4	CHROMIUM	3.1E+00	2.6E-02		1.4E+00	6.1E+00	1.1E+01
4	ZINC	1.1E+00	1.2E-03		1.2E+00	3.7E+00	6.0E+00
4	VANADIUM	2.1E+00	2.0E-02		2.4E-01	1.5E+00	3.8E+00
4	CADMIUM	2.5E+00	2.3E-03		4.7E-01	7.1E-02	3.1E+00
4	SILVER	8.8E-01	1.8E-03		1.8E+00	2.7E-01	3.0E+00
4	BARIUM	1.6E+00	1.3E-02		1.7E-01	2.5E-02	1.8E+00
4	ARSENIC	1.6E+00	1.6E-02		1.5E-04	2.2E-03	1.6E+00
4	NICKEL	8.3E-01	4.1E-03		1.6E-01	9.7E-02	1.1E+00
4	URANIUM	3.9E-01	3.7E-03	7.7E-04	5.4E-02	2.7E-01	7.2E-01
4	BERYLLIUM	8.4E-02			3.8E-05	2.8E-02	1.1E-01
4	Pathway total	2.1E+02	4.1E-01	3.1E-03	7.7E+01	2.5E+02	5.4E+02

Table C6b (continued)

Reach	Inorganic contaminant	Vegetable ingestion	Sediment ingestion	Dust inhalation	Milk ingestion	Meat ingestion	Multiple pathway total
R5	MERCURY, TOTAL	8.1E+01	1.2E-01		6.0E+00	3.6E+01	1.2E+02
5	ZINC	1.4E+00	1.6E-03		1.6E+00	4.9E+00	7.9E+00
5	CHROMIUM	1.9E+00	1.5E-02		8.1E-01	3.7E+00	6.4E+00
5	ARSENIC	2.4E+00	2.3E-02		2.2E-04	3.2E-03	2.4E+00
5	SELENIUM	1.1E-01	3.8E-04	1.3E-05	2.4E-01	7.2E-01	1.1E+00
5	NICKEL	3.5E-01	1.7E-03		6.7E-02	4.0E-02	4.5E-01
5	CADMIUM	1.2E-01	1.1E-04		2.2E-02	3.3E-03	1.4E-01
5	BERYLLIUM	5.0E-02	4.6E-04		2.3E-05	1.7E-02	6.7E-02
5	Pathway total	8.8E+01	1.6E-01	1.3E-05	8.8E+00	4.5E+01	1.4E+02
R10	ARSENIC	3.5E+00	3.4E-02		3.2E-04	4.8E-03	3.6E+00
10	CHROMIUM	8.0E-01	6.6E-03		3.5E-01	1.6E+00	2.7E+00
10	NICKEL	3.9E-01	1.9E-03		7.6E-02	4.5E-02	5.1E-01
10	MERCURY, TOTAL	3.3E-01	4.8E-04		2.5E-02	1.5E-01	5.1E-01
10	URANIUM	2.2E-01	2.0E-03		2.9E-02	1.5E-01	3.9E-01
10	Pathway total	5.3E+00	4.5E-02		4.8E-01	1.9E+00	7.7E+00
R13	ARSENIC	2.1E+01	2.0E-01		1.9E-03	2.8E-02	2.1E+01
13	ZINC	6.4E-01	7.1E-04		7.4E-01	2.2E+00	3.6E+00
13	NICKEL	1.1E+00	5.4E-03		2.1E-01	1.3E-01	1.4E+00
13	CYANIDE	2.2E-02	2.1E-04		5.0E-04	3.0E-04	2.3E-02
13	Pathway total	2.2E+01	2.1E-01		9.5E-01	2.4E+00	2.6E+01
R18	MERCURY	1.5E+02	2.1E-01		1.1E+01	6.6E+01	2.3E+02
18	CHROMIUM	3.1E+00	2.6E-02		1.4E+00	6.1E+00	1.1E+01
18	ARSENIC	1.1E+00	1.1E-02		1.0E-04	1.5E-03	1.1E+00
18	CADMIUM	2.4E-02	2.1E-05		4.4E-03	6.6E-04	2.9E-02
18	Pathway total	1.5E+02	2.5E-01		1.2E+01	7.2E+01	2.4E+02

Table C7a. Noncarcinogen screening indices for organic compounds using maximum concentrations and conservative estimates of exposure (Exposure pathways based on consumption of water and fish and the assumed use of water for irrigation)

Reach	Organic compound	Fish ingestion	Water ingestion	Meat ingestion	Milk ingestion	Vegetable ingestion	Soil ingestion	Multiple pathway total
R1								
1	CHLORDANE	7.6E-01	5.0E-01	1.6E-03	1.7E-03	1.9E+00	4.0E-02	3.2E+00
1	METHYLENE CHLORIDE	1.2E-03	3.3E-02	1.4E-05	1.4E-05	6.2E-01	2.6E-03	6.5E-01
1	P,P'DDT	9.1E-02	1.1E-04	7.0E-04	7.4E-04	1.7E-04	8.7E-06	9.3E-02
1	BIS (2-ETHYLHEXYL) PHTHALATE	4.7E-02	8.3E-04	1.8E-04	1.9E-04	1.4E-03	6.6E-05	5.0E-02
1	Pathway total	9.0E-01	5.3E-01	2.5E-03	2.6E-03	2.5E+00	4.2E-02	4.0E+00
R2								
2	CHLORDANE	1.2E+00	7.8E-01	2.5E-03	2.7E-03	3.0E+00	6.2E-02	5.0E+00
2	P,P'DDT	5.1E-02	6.2E-05	3.9E-04	4.1E-04	9.5E-05	4.9E-06	5.2E-02
2	BIS (2-ETHYLHEXYL) PHTHALATE	9.6E-03	7.2E-04	1.6E-04	1.6E-04	1.2E-03	5.7E-05	1.2E-02
2	Pathway total	1.3E+00	7.8E-01	3.1E-03	3.2E-03	3.0E+00	6.2E-02	5.1E+00
R3								
3	TRANS-1,3-DICHLOROPROPENE	3.0E-01	8.1E-01	8.2E-04	8.6E-04	6.6E+00	6.4E-02	7.8E+00
3	CARBON TETRACHLORIDE	2.0E-02	3.9E-01	1.4E-03	1.4E-03	1.4E+00	3.1E-02	1.9E+00
3	TRANS-1,2-DICHLOROETHENE	7.1E-04	8.6E-02	4.7E-05	4.9E-05	1.2E+00	6.8E-03	1.3E+00
3	METHYLENE CHLORIDE	1.2E-03	5.7E-02	2.4E-05	2.5E-05	1.1E+00	4.5E-03	1.1E+00
3	CHLOROFORM	1.4E-03	7.3E-02	7.3E-05	7.7E-05	6.0E-01	5.8E-03	6.8E-01
3	TETRACHLOROETHYLENE	1.4E-03	1.4E-01	1.3E-03	1.4E-03	3.5E-01	1.1E-02	5.0E-01
3	BIS (2-ETHYLHEXYL) PHTHALATE	9.6E-03	3.7E-02	7.9E-03	8.4E-03	6.1E-02	2.9E-03	1.3E-01
3	1,1,1-TRICHLOROETHANE	1.6E-04	1.4E-02	2.9E-05	3.1E-05	7.0E-02	1.1E-03	8.5E-02
3	DICHLORODIFLUOROMETHANE	7.1E-05	1.1E-02	1.4E-05	1.5E-05	7.2E-02	8.5E-04	8.4E-02
3	TRICHLOROFLUOROMETHANE	4.8E-05	2.3E-03	5.0E-06	5.3E-06	1.1E-02	1.8E-04	1.3E-02
3	DI-N-BUTYL PHTHALATE	1.4E-03	2.2E-05	4.9E-06	5.2E-06	3.7E-05	1.8E-06	1.5E-03
3	Pathway total	3.4E-01	1.6E+00	1.2E-02	1.2E-02	1.1E+01	1.3E-01	1.4E+01

Table C7a (continued)

Reach	Organic compound	Fish ingestion	Water ingestion	Meat ingestion	Milk	Vegetable ingestion	Soil ingestion	Multiple pathway total
R4								
4	CHLORDANE	1.4E+00	9.3E-01	3.0E-03	3.2E-03	3.5E+00	7.4E-02	6.0E+00
4	BIS (2-ETHYLHEXYL) PHTHALATE	4.6E-03	7.6E-05	1.6E-05	1.7E-05	1.3E-04	6.0E-06	4.9E-03
4	Pathway total	1.4E+00	9.3E-01	3.0E-03	3.2E-03	3.5E+00	7.4E-02	6.0E+00

All other reaches had concentrations of noncarcinogenic organics that were below the limits of detection.

Table C7b. Noncarcinogen screening indices for organic compounds using maximum concentrations and conservative estimates of exposure (Exposure pathways based on assumed dredging of sediment and its subsequent use as agricultural soil)

Reach	Organic compound	Vegetable ingestion	Sediment ingestion	Dust inhalation	Milk ingestion	Meat ingestion	Multiple pathway total
R1							
1	CHLORDANE	5.7E-01	9.9E-04		4.7E-04	4.5E-04	5.8E-01
1	P,P'DDT	5.4E-02	5.2E-04		2.3E-01	2.2E-01	5.1E-01
1	BIS (2-ETHYLHEXYL) PHTHALATE	2.0E-02	1.6E-04		2.7E-03	2.6E-03	2.6E-02
1	METHYLENE CHLORIDE	9.0E-03	2.4E-06		2.1E-07	1.9E-07	9.0E-03
1	Pathway total	6.6E-01	1.7E-03		2.4E-01	2.3E-01	1.1E+00
R2							
2	CHLORDANE	9.0E-01	1.5E-03		7.4E-04	7.0E-04	9.0E-01
2	P,P'DDT	3.1E-02	2.9E-04		1.3E-01	1.2E-01	2.9E-01
2	BIS (2-ETHYLHEXYL) PHTHALATE	1.8E-02	1.4E-04		2.3E-03	2.2E-03	2.2E-02
2	Pathway total	9.5E-01	2.0E-03		1.3E-01	1.3E-01	1.2E+00
R3							
3	BIS (2-ETHYLHEXYL) PHTHALATE	9.0E-01	6.9E-03		1.2E-01	1.1E-01	1.1E+00
3	CARBON TETRACHLORIDE	4.7E-01	8.6E-04		4.4E-04	4.1E-04	4.7E-01
3	TRANS-1,3-DICHLOROPROPENE	4.3E-01	2.9E-04		5.3E-05	5.1E-05	4.3E-01
3	TETRACHLOROETHYLENE	3.2E-01	1.0E-03		1.2E-03	1.1E-03	3.3E-01
3	CHLOROFORM	3.8E-02	2.5E-05		4.6E-06	4.4E-06	3.8E-02
3	TRANS-1,2-DICHLOROETHENE	2.9E-02	1.0E-05		1.1E-06	1.1E-06	2.9E-02
3	METHYLENE CHLORIDE	1.6E-02	4.2E-06		3.6E-07	3.4E-07	1.6E-02
3	1,1,1-TRICHLOROETHANE	1.2E-02	1.5E-05		5.1E-06	4.8E-06	1.2E-02
3	DICHLORODIFLUOROMETHANE	6.7E-03	5.6E-06		1.3E-06	1.2E-06	6.7E-03
3	TRICHLOROFLUOROMETHANE	2.0E-03	2.6E-06		9.3E-07	8.8E-07	2.0E-03
3	DI-N-BUTYL PHTHALATE	5.6E-04	4.3E-06		7.5E-05	7.1E-05	7.1E-04
3	Pathway total	2.2E+00	9.2E-03		1.2E-01	1.1E-01	2.5E+00

Table C7b (continued)

Reach	Organic compound	Vegetable ingestion	Sediment ingestion	Dust inhalation	Milk ingestion	Meat ingestion	Multiple pathway total
R4							
4	CHLORDANE	1.1E+00	1.8E-03		8.8E-04	8.4E-04	1.1E+00
4	BIS (2-ETHYLHEXYL) PHTHALATE	1.9E-03	1.4E-05		2.5E-04	2.3E-04	2.4E-03
4	Pathway total	1.1E+00	1.9E-03		1.1E-03	1.1E-03	1.1E+00

All other reaches had concentrations of noncarcinogenic organics that were below the limits of detection.

Appendix D

RESULTS OF NONCONSERVATIVE SCREENING



Table D1. Summation of screening indices for carcinogens by reach,
exposure pathway, and contaminant type using mean
concentrations and nonconservative
estimates of exposure

Reach	Contaminant type	Sediment ingestion	Fish ingestion	Water ingestion	Sediment external
R1	Inorganics	4.6E-06	1.2E-05	1.3E-03	
R1	Organics	9.8E-07	1.4E-04		
R1	Radionuclides	3.3E-07	1.4E-07	2.0E-06	5.0E-05
R1	Pathway total	5.9E-06	1.5E-04	1.3E-03	5.0E-05
R2	Inorganics	2.2E-06	2.2E-05	1.4E-04	
R2	Organics	3.1E-06	3.5E-04		
R2	Radionuclides	5.8E-06	2.3E-06	1.3E-04	1.3E-03
R2	Pathway total	1.1E-05	3.7E-04	2.8E-04	1.3E-03
R3	Inorganics	5.8E-06	2.1E-05	6.8E-05	
R3	Organics	5.6E-06	6.1E-04	9.2E-05	
R3	Radionuclides	1.0E-06	2.7E-08		1.6E-04
R3	Pathway total	1.2E-05	6.3E-04	1.6E-04	1.6E-04
R4	Inorganics	3.5E-06	1.3E-05	3.1E-05	
R4	Organics		2.5E-04		
R4	Radionuclides	5.3E-07	5.3E-07	2.1E-06	1.2E-04
R4	Pathway total	4.0E-06	2.7E-04	3.3E-05	1.2E-04
R5	Inorganics	5.0E-06	1.5E-05		
R5	Organics		5.0E-04		
R5	Radionuclides	3.2E-08			1.5E-05
R5	Pathway total	5.0E-06	5.1E-04		1.5E-05
R10	Inorganics	5.0E-06			
R10	Radionuclides	1.9E-08			6.0E-06
R10	Pathway total	5.0E-06			6.0E-06
R13	Inorganics			3.4E-05	
R13	Pathway total			3.4E-05	
R18	Inorganics		1.5E-05		
R18	Organics		1.4E-04		
R18	Radionuclides	1.8E-09			1.3E-06
R18	Pathway total	1.8E-09	1.6E-04		1.3E-06

Table D2. Summation of screening indices for noncarcinogens by reach, exposure pathway, and contaminant type using mean concentrations and nonconservative estimates of exposure

Reach	Contaminant type	Sediment ingestion	Fish ingestion	Water ingestion
R1	Inorganics	3.5E-03	1.5E+00	7.7E-01
R1	Organics	1.6E-05	1.1E-01	
R1	Pathway total	3.6E-03	1.6E+00	7.7E-01
R2	Inorganics	7.7E-03	7.5E-01	9.3E-02
R2	Organics	1.3E-05	1.9E-01	
R2	Pathway total	7.7E-03	9.4E-01	9.3E-02
R3	Inorganics	1.6E-02	8.2E-01	8.3E-01
R3	Organics	6.5E-05		3.0E-02
R3	Pathway total	1.6E-02	8.2E-01	8.6E-01
R4	Inorganics	1.2E-02	5.9E-02	3.3E-02
R4	Organics		2.1E-01	
R4	Pathway total	1.2E-02	2.7E-01	3.3E-02
R5	Inorganics	4.1E-03	3.0E-02	
R5	Pathway total	4.1E-03	3.0E-02	
R10	Inorganics	3.9E-03		
R10	Pathway total	3.9E-03		
R13	Inorganics			3.7E-02
R13	Pathway total			3.7E-02
R18	Inorganics		4.1E-02	
R18	Pathway total		4.1E-02	

Table D3. Carcinogen screening indices for inorganics
by reach and pathway using mean concentrations
with nonconservative estimates of exposure

Reach	Inorganic contaminant	Exposure pathways		
		Sediment ingestion	Fish ingestion	Drinking water
1	ARSENIC	3.6E-06	6.3E-06	1.3E-03
1	BERYLLIUM	9.8E-07	5.4E-06	
1	URANIUM	4.7E-12		
R1	Pathway total	4.6E-06	1.2E-05	1.3E-03
2	ARSENIC	2.2E-06	1.7E-05	1.3E-04
2	BERYLLIUM		4.6E-06	1.4E-05
2	URANIUM	1.8E-12		
R2	Pathway total	2.2E-06	2.2E-05	1.4E-04
3	ARSENIC	5.8E-06	1.7E-05	5.3E-05
3	BERYLLIUM		4.6E-06	1.5E-05
3	URANIUM	1.4E-11		4.7E-09
R3	Pathway total	5.8E-06	2.1E-05	6.8E-05
4	ARSENIC	2.0E-06	1.3E-05	3.1E-05
4	BERYLLIUM	1.5E-06		
4	URANIUM	2.1E-12		4.7E-11
R4	Pathway total	3.5E-06	1.3E-05	3.1E-05
5	ARSENIC	4.0E-06	1.5E-05	
5	BERYLLIUM	9.8E-07		
R5	Pathway total	5.0E-06	1.5E-05	
10	ARSENIC	5.0E-06		
10	URANIUM	3.4E-12		
R10	Pathway total	5.0E-06		
13	ARSENIC			3.4E-05
13	URANIUM			1.1E-10
R13	Pathway total			3.4E-05
18	ARSENIC		1.5E-05	
R18	Pathway total		1.5E-05	

Table D4. Carcinogen screening indices for organics
by reach and pathway using mean concentrations
and nonconservative estimates of exposure

Reach	Organic compound	Exposure Pathways		
		Sediment ingestion	Fish ingestion	Drinking water
1	PCB-1260 (AROCLOR 1260)		8.4E-05	
1	PCB-1254 (AROCLOR 1254)		4.6E-05	
1	CHLORDANE		8.9E-06	
1	P,P'DDD		1.0E-06	
1	FLUORANTHENE	9.7E-07		
1	BIS (2-ETHYLHEXYL) PHTHALATE	4.4E-09		
1	METHYLENE CHLORIDE	1.1E-10		
R1	Pathway total	9.8E-07	1.4E-04	
2	PCB-1260 (AROCLOR 1260)	1.8E-06	2.1E-04	
2	PCB-1254 (AROCLOR 1254)	1.3E-06	1.2E-04	
2	CHLORDANE		1.4E-05	
2	P,P'DDT		1.3E-06	
2	BIS (2-ETHYLHEXYL) PHTHALATE	3.5E-09		
R2	Pathway total	3.1E-06	3.5E-04	
3	PCB-1260 (AROCLOR 1260)		4.7E-04	
3	PCB-1254 (AROCLOR 1254)		1.4E-04	3.9E-05
3	VINYL CHLORIDE			4.9E-05
3	CARBON TETRACHLORIDE			2.4E-06
3	PYRENE	1.2E-06		
3	CHRYSENE	1.2E-06		
3	FLUORANTHENE	1.1E-06		
3	TRICHLOROETHYLENE			9.8E-07
3	PHENANTHRENE	9.5E-07		
3	TETRACHLOROETHYLENE			9.2E-07
3	BENZO(A)ANTHRACENE	8.2E-07		
3	ANTHRACENE	4.0E-07		
3	BIS (2-ETHYLHEXYL) PHTHALATE	1.8E-08		3.4E-07
3	METHYLENE CHLORIDE			1.4E-07
R3	Pathway total	5.6E-06	6.1E-04	9.3E-05
4	PCB-1254 (AROCLOR 1254)		1.2E-04	
4	PCB-1260 (AROCLOR 1260)		1.2E-04	
4	CHLORDANE		1.7E-05	
R4	Pathway total		2.5E-04	

Table D4 (continued)

Reach	Organic compound	Exposure Pathways		
		Sediment ingestion	Fish ingestion	Drinking water
5	PCB-1260 (AROCLOR 1260)		2.9E-04	
5	PCB-1254 (AROCLOR 1254)		2.1E-04	
R5	Pathway total		5.0E-04	
18	PCB-1254 (AROCLOR 1254)		1.1E-04	
18	PCB-1260 (AROCLOR 1260)		3.3E-05	
R18	Pathway total		1.4E-04	

All other reaches had concentrations of organics that were below the limits of detection.

Table D5. Carcinogen screening indices for radionuclides by reach and pathway using mean concentrations and nonconservative estimates of exposure

Reach	Radionuclide	Exposure pathways			
		Sediment ingestion	Fish ingestion	Water ingestion	Sediment external
1	Pa-234	6.8E-10			3.9E-05
1	Cs-137	7.1E-09	6.7E-08	4.5E-07	5.3E-06
1	Co-60	8.2E-10	6.7E-09		4.4E-06
1	Sr-90	1.6E-09	2.8E-08	1.3E-06	
1	U-238	1.3E-08	1.2E-08	6.9E-08	3.5E-07
1	U-235	8.1E-09	4.4E-09	4.8E-08	3.7E-07
1	Th-232	2.8E-07			4.5E-09
1	U-234	2.2E-08	2.1E-08	1.2E-07	9.0E-09
1	Sr-89	2.7E-10			1.1E-07
1	Pu-239	9.6E-10	1.0E-09		5.6E-11
1	Pu-238	1.2E-10	1.9E-09		1.7E-11
1	Tc-99		1.5E-09		
1	U-236			1.2E-10	
1	Pathway total	3.3E-07	1.4E-07	2.0E-06	5.0E-05
2	Cs-137	1.3E-06	1.6E-06	8.6E-06	9.6E-04
2	Co-60	3.2E-08	3.1E-08	9.4E-07	1.7E-04
2	Sr-90	5.9E-08	4.0E-07	6.8E-05	
2	Eu-154	8.2E-09			6.7E-05
2	Eu-152	5.7E-09			6.3E-05
2	H-3			5.4E-05	
2	Pa-234	4.1E-10			2.4E-05
2	U-238	4.3E-07	9.3E-09	5.2E-08	1.2E-05
2	Cs-134	8.8E-09			1.2E-05
2	Am-241	3.3E-06		1.7E-06	2.9E-06
2	Sr-89	6.8E-09	1.3E-07		2.7E-06
2	Cm-244	5.3E-07		1.1E-06	2.6E-08
2	U-235	3.4E-08	1.6E-09	4.8E-08	1.5E-06
2	Pu-239	1.6E-08	5.0E-08	8.4E-08	9.0E-10
2	Th-234	2.4E-09			1.1E-07
2	U-234		1.7E-08	8.2E-08	
2	Pu-238	1.5E-09	1.9E-09	3.7E-08	2.1E-10
2	U-236			1.4E-10	
2	Pathway total	5.8E-06	2.3E-06	1.3E-04	1.3E-03

Table D5 (continued)

Reach	Radionuclide	Exposure pathways			
		Sediment ingestion	Fish ingestion	Water ingestion	Sediment external
3	Pa-234	1.7E-09			1.0E-04
3	U-238	8.7E-07			2.3E-05
3	Co-60	3.9E-09			2.1E-05
3	Cs-137	1.0E-08			7.5E-06
3	U-235	8.5E-08			3.9E-06
3	Cs-134	1.0E-09			1.4E-06
3	Th-234	7.2E-09			3.4E-07
3	Pa-233	1.3E-11			5.5E-08
3	Sr-90	3.6E-09	2.3E-08		
3	Am-241	9.0E-09			7.8E-09
3	Tc-99		3.5E-09		
3	Pu-239	2.1E-09			1.2E-10
3	Cm-244	1.2E-09			5.7E-11
3	Pu-238	4.6E-10			6.8E-11
3	Pathway total	1.0E-06	2.7E-08		1.6E-04
4	Cs-137	1.2E-07	3.4E-07		8.8E-05
4	Co-60	3.5E-09	8.0E-09		1.9E-05
4	U-238	2.9E-07	2.6E-08	4.9E-08	7.9E-06
4	U-235	3.5E-08	6.3E-09	4.8E-08	1.6E-06
4	Sr-90	1.4E-08	8.9E-08	1.6E-06	
4	H-3			3.4E-07	
4	Sr-89	5.7E-10	8.1E-09		2.3E-07
4	Th-234	4.4E-09			2.1E-07
4	U-234		4.8E-08	8.2E-08	
4	Am-241	5.0E-08			4.4E-08
4	Pu-239	9.7E-09	1.6E-09		5.6E-10
4	Cm-244	5.1E-09			2.5E-10
4	Tc-99		3.8E-09		
4	Pu-238	6.9E-10	1.4E-09		1.0E-10
4	U-236			2.8E-10	
4	Pathway total	5.3E-07	5.3E-07	2.1E-06	1.2E-04

Table D5 (continued)

Reach	Radionuclide	Exposure pathways			
		Sediment ingestion	Fish ingestion	Water ingestion	Sediment external
5	Cs-137	1.5E-08			1.1E-05
5	Co-60	5.9E-10			3.1E-06
5	Sr-90	1.4E-08			
5	Pu-239	2.1E-09			1.2E-10
5	Pu-238	1.9E-10			2.7E-11
5	Pathway total	3.2E-08			1.5E-05
10	Cs-137	6.2E-09			4.6E-06
10	Sr-89	3.4E-09			1.3E-06
10	Am-241	4.2E-09			3.6E-09
10	Sr-90	4.1E-09			
10	Cm-244	8.4E-10			4.1E-11
10	Pathway total	1.9E-08			6.0E-06
18	Cs-137	1.8E-09			1.3E-06
18	Pathway total	1.8E-09			1.3E-06

Table D6. Noncarcinogen screening indices for inorganics
by reach and pathway using mean concentrations
and nonconservative estimates of exposure

Reach	Inorganic contaminant	Exposure pathways		
		Sediment ingestion	Fish ingestion	Drinking water
1	THALLIUM		1.35E+00	
1	ARSENIC	2.07E-03	3.61E-03	7.36E-01
1	ANTIMONY	1.07E-04	1.07E-01	
1	SELENIUM	9.52E-05	9.65E-03	2.38E-02
1	MERCURY, TOTAL	5.00E-05	1.26E-02	
1	CHROMIUM	6.29E-04	5.60E-04	4.29E-03
1	SILVER		4.16E-03	
1	NICKEL	1.66E-04	2.14E-03	1.43E-03
1	ZINC	9.64E-05	1.56E-03	7.14E-05
1	BERYLLIUM	4.57E-05	2.51E-04	
1	URANIUM	2.81E-04		
1	CADMIUM	7.94E-07	6.31E-06	
1	CYANIDE	2.86E-06		
1	Pathway total	3.5E-03	1.5E+00	7.7E-01
2	THALLIUM		6.12E-01	
2	ANTIMONY		1.07E-01	
2	ARSENIC	1.27E-03	9.70E-03	7.24E-02
2	MERCURY, TOTAL	9.32E-04	1.19E-02	1.79E-03
2	CHROMIUM	1.48E-03	7.71E-04	1.07E-02
2	NICKEL	1.29E-04	2.14E-03	5.01E-03
2	SELENIUM	3.55E-03	3.73E-03	
2	SILVER	2.00E-04	5.36E-03	1.19E-03
2	ZINC	3.75E-05	1.57E-03	5.72E-04
2	CYANIDE			9.82E-04
2	BERYLLIUM		2.14E-04	6.57E-04
2	URANIUM	1.06E-04		
2	CADMIUM	2.64E-06	3.45E-06	8.85E-05
2	Pathway total	7.7E-03	7.5E-01	9.3E-02

Table D6 (continued)

Reach	Inorganic contaminant	Exposure pathways		
		Sediment ingestion	Fish ingestion	Drinking water
3	THALLIUM		6.12E-01	
3	ANTIMONY		1.07E-01	4.64E-01
3	URANIUM	8.46E-04		2.82E-01
3	MERCURY, TOTAL	5.26E-03	7.00E-02	1.05E-04
3	ARSENIC	3.32E-03	9.43E-03	3.00E-02
3	NICKEL	8.82E-04	3.21E-03	1.71E-02
3	SILVER	2.49E-04	5.71E-03	1.19E-02
3	CHROMIUM	1.31E-03	1.39E-03	8.45E-03
3	SELENIUM	4.15E-03	3.98E-03	
3	BORON			7.70E-03
3	CYANIDE			3.14E-03
3	ZINC	9.90E-05	1.70E-03	6.59E-04
3	BERYLLIUM		2.14E-04	7.14E-04
3	CADMIUM	3.10E-06	4.73E-06	1.15E-04
3	TIN			6.51E-05
3	Pathway total	1.6E-02	8.2E-01	8.3E-01
4	MERCURY, TOTAL	1.41E-03	2.68E-02	2.38E-03
4	ARSENIC	1.15E-03	7.65E-03	1.79E-02
4	SELENIUM	5.35E-03	1.93E-02	
4	NICKEL	1.32E-04	2.14E-03	9.02E-03
4	URANIUM	1.27E-04		2.81E-03
4	ZINC	3.84E-05	2.22E-03	5.49E-04
4	VANADIUM	1.88E-03		
4	CHROMIUM	4.81E-04	9.54E-04	
4	BARIUM	1.25E-03		
4	CYANIDE			7.59E-04
4	BORON	2.24E-04		
4	SILVER	1.21E-04		
4	CADMIUM	1.51E-06	4.09E-06	7.94E-05
4	BERYLLIUM	6.89E-05		
4	Pathway total	1.2E-02	5.9E-02	3.3E-02

Table D6 (continued)

Reach	Inorganic contaminant	Exposure pathways		
		Sediment ingestion	Fish ingestion	Drinking water
5	MERCURY, TOTAL	3.34E-04	1.92E-02	
5	ARSENIC	2.29E-03	8.57E-03	
5	CHROMIUM	1.03E-03	1.97E-03	
5	NICKEL	1.71E-04		
5	ZINC	1.57E-04		
5	BERYLLIUM	4.57E-05		
5	SELENIUM	3.81E-05		
5	CADMIUM		7.14E-06	
5	Pathway total	4.1E-03	3.0E-02	
10	ARSENIC	2.86E-03		
10	CHROMIUM	6.29E-04		
10	URANIUM	2.02E-04		
10	NICKEL	1.82E-04		
10	MERCURY, TOTAL	4.76E-05		
10	Pathway total	3.9E-03		
13	ARSENIC			1.96E-02
13	NICKEL			8.93E-03
13	URANIUM			6.79E-03
13	CYANIDE			9.82E-04
13	ZINC			4.73E-04
13	Pathway total			3.7E-02
18	MERCURY, TOTAL		3.05E-02	
18	ARSENIC		8.57E-03	
18	CHROMIUM		1.85E-03	
18	CADMIUM		2.96E-06	
18	Pathway total		4.1E-02	

Table D7. Noncarcinogen screening indices for organics
by reach and pathway using mean concentrations
and nonconservative estimates of exposure

Reach	Organic compound	Exposure Pathways		
		Sediment ingestion	Fish ingestion	Drinking water
1	CHLORDANE			1.1E-01
1	BIS (2-ETHYLHEXYL) PHTHALATE	1.6E-05		
1	METHYLENE CHLORIDE	2.4E-07		
1	Pathway total	1.6E-05	1.1E-01	
2	CHLORDANE			1.8E-01
2	P,P'DDT			7.7E-03
2	BIS (2-ETHYLHEXYL) PHTHALATE	1.3E-05		
2	Pathway total	1.3E-05	1.9E-01	
3	CARBON TETRACHLORIDE			2.6E-02
3	TETRACHLOROETHYLENE			1.8E-03
3	BIS (2-ETHYLHEXYL) PHTHALATE	6.5E-05		1.2E-03
3	METHYLENE CHLORIDE			3.2E-04
3	1,1,1-TRICHLOROETHANE			2.0E-04
3	DICHLORODIFLUOROMETHANE			1.9E-04
3	TRICHLOROFUOROMETHANE			5.6E-05
3	DI-N-BUTYL PHTHALATE	1.9E-07		
3	Pathway total	6.5E-05	3.0E-02	
4	CHLORDANE			2.1E-01
4	Pathway total		2.1E-01	

All other reaches had concentrations of organics that were below the limits of detection.

Appendix E

**RESULTS OF NONCONSERVATIVE SCREENING FOR THE LOWEST REPORTED
LESS-THAN-DETECTABLE QUANTITIES OF CONTAMINANTS**



Table E1. Lowest limits of detection reported in the data base
for inorganic compounds

Inorganic chemical	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
ALUMINUM			1.0E-02
ANTIMONY		1.0E+00	5.0E-02
ARSENIC	5.0E+00	2.0E-02	1.0E-03
BARIUM			1.0E-01
BERYLLIUM		2.0E-02	5.0E-04
BORON			4.0E-03
CADMIUM	3.0E-01	2.0E-03	1.0E-03
CHROMIUM		2.0E-02	1.0E-02
COPPER	4.0E-01	1.0E-01	2.0E-03
CYANIDE	7.0E-01		2.0E-03
LEAD	5.0E+00	2.0E-02	1.0E-03
LITHIUM			1.0E-03
MERCURY	1.0E-01	1.0E-01	5.0E-05
MOLYBDENUM			1.0E-02
NICKEL		1.0E+00	1.0E-03
NIOBIUM			7.0E-03
SELENIUM	5.0E+00	2.0E-02	1.0E-03
SILVER	6.0E-01	2.0E-01	1.0E-03
THALLIUM	5.0E+00	1.0E+00	1.0E-02
THORIUM	2.0E+01		2.0E-01
TIN			1.0E-02
TITANIUM			3.0E-03
URANIUM	2.0E-01		1.0E-03
VANADIUM			6.0E-03
ZINC	1.0E-01		1.0E-03
ZIRCONIUM			1.0E-03

Table E2. Lowest limits of detection reported in the data base
for organic compounds

Organic compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
1,1,1-TRICHLOROETHANE	8.0E-03	5.0E-02	5.0E-03
1,1,2,2-TETRACHLOROETHANE	8.0E-03	5.0E-02	5.0E-03
1,1,2-TRICHLOROETHANE	8.0E-03	5.0E-02	
1,1-DICHLOROETHANE	8.0E-03	5.0E-02	5.0E-03
1,1-DICHLOROETHYLENE	8.0E-03	5.0E-02	5.0E-03
1,2,4-TRICHLOROBENZENE	5.0E-01	4.1E-01	5.0E-03
1,2,5,6-DIBENZANTHRAZENE	5.0E-01	4.1E-01	5.0E-03
1,2-DICHLOROBENZENE	5.0E-01	4.1E-01	5.0E-03
1,2-DICHLOROETHANE	8.0E-03	5.0E-02	5.0E-03
1,2-DICHLOROPROPANE	8.0E-03	5.0E-02	5.0E-03
1,2-DIPHENYLHYDRAZINE	5.0E-01	4.1E-01	
1,3-DICHLOROBENZENE	5.0E-01	4.1E-01	5.0E-03
1,3-DICHLOROPROPENE	8.0E-03	5.0E-02	5.0E-03
1,4-DICHLOROBENZENE	5.0E-01	4.1E-01	5.0E-03
2,4,6-TRICHLOROPHENOL	5.0E-01	4.1E-01	5.0E-03
2,4-DICHLOROPHENOL	5.0E-01	4.1E-01	5.0E-03
2,4-DIMETHYLPHENOL	5.0E-01	4.1E-01	5.0E-03
2,4-DINITROPHENOL	5.0E+00	4.1E+00	5.0E-03
2,4-DINITROTOLUENE	5.0E-01	4.1E-01	5.0E-03
2,6-DINITROTOLUENE	5.0E-01	4.1E-01	5.0E-03
2-CHLOROETHYL VINYL ETHER	8.0E-03	5.0E-02	1.0E-02
2-CHLORONAPHTHALENE	5.0E-01	4.1E-01	5.0E-03
2-CHLOROPHENOL	5.0E-01	4.1E-01	5.0E-03
2-NITROPHENOL	5.0E-01	4.1E-01	5.0E-03
3,3'-DICHLOROBENZIDINE	1.6E+00	1.0E+00	1.0E-02
4,6-DINITRO-O-RTHO-CRESOL	2.5E+00	2.1E+00	2.5E-02
4-BROMOPHENYL PHENYL ETHER	5.0E-01	4.1E-01	5.0E-03
4-CHLOROPHENYL PHENYL ETHER	5.0E-01	4.1E-01	5.0E-03
4-NITROPHENOL	5.0E-01	4.1E-01	2.5E-02
ACENAPHTHENE	4.0E-03	4.1E-01	5.0E-03
ACENAPHTHYLENE	5.0E-01	4.1E-01	5.0E-03
ACROLEIN	8.0E-02	5.0E-02	
ACRYLONITRILE	8.0E-02	5.0E-02	
ALDRIN	5.0E-01	1.0E-02	
ALPHA BHC	5.0E-01	1.0E-02	
ANTHRACENE	2.0E-03	4.1E-01	5.0E-03
BENZENE	8.0E-03	5.0E-02	5.0E-03
BENZIDINE	3.2E+00	2.1E+00	5.0E-03
BENZO(A)ANTHRACENE	8.0E-03	4.1E-01	5.0E-03
BENZO(B)FLUORANTHENE	5.0E-01	4.1E-01	5.0E-03
BENZO(GH)PERYLENE	5.0E-01	4.1E-01	5.0E-03

Table E2 (continued)

Organic compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
BENZO(K)FLUORANTHENE	5.0E-01	4.1E-01	5.0E-03
BENZO-A-PYRENE	5.0E-01	4.1E-01	5.0E-03
BETA BHC	5.0E-01	1.0E-02	
BIS (2-CHLOROETHOXY) METHANE	5.0E-01	4.1E-01	5.0E-03
BIS (2-CHLOROETHYL) ETHER	5.0E-01	4.1E-01	5.0E-03
BIS (2-CHLOROISOPROPYL) ETHER	5.0E-01	4.1E-01	5.0E-03
BIS (2-ETHYLHEXYL) PHTHALATE	3.0E-03	4.1E-01	5.0E-03
BIS (CHLOROMETHYL) ETHER	8.0E-03	5.0E-02	
BROMOFORM	8.0E-03	5.0E-02	5.0E-03
CARBON TETRACHLORIDE	8.0E-03	5.0E-02	5.0E-03
CHLORDANE	2.5E+00	1.0E-02	
CHLOROBENZENE	8.0E-03	5.0E-02	5.0E-03
CHLORODIBROMOMETHANE	8.0E-03	5.0E-02	5.0E-03
CHLOROETHANE	8.0E-03	5.0E-02	1.0E-02
CHLOROFORM	8.0E-03	5.0E-02	5.0E-03
CHRYSENE	3.0E-03	4.1E-01	5.0E-03
DELTA BHC	5.0E-01	1.0E-02	
DI-N-BUTYL PHTHALATE	3.0E-03	4.1E-01	5.0E-03
DI-N-OCTYL PHTHALATE	5.0E-01	4.1E-01	5.0E-03
DICHLOROBROMOMETHANE	8.0E-03	5.0E-02	5.0E-03
DICHLORODIFLUOROMETHANE	8.0E-03	5.0E-02	5.0E-03
DIELDRIN	5.0E-01	1.0E-02	
DIETHYL PHTHALATE	6.3E-01	4.1E-01	5.0E-03
DIMETHYL PHTHALATE	5.0E-01	4.1E-01	5.0E-03
ENDOSULFAN SULFATE	5.0E-01	1.0E-02	
ENDOSULFAN, ALPHA	5.0E-01	1.0E-02	
ENDOSULFAN, BETA	5.0E-01	1.0E-02	
ENDRIN	5.0E-01	1.0E-02	
ENDRIN ALDEHYDE	5.0E-01	1.0E-02	
ETHYLBENZENE	8.0E-03	5.0E-02	5.0E-03
FLUORANTHENE	2.0E-03	4.1E-01	5.0E-03
FLUORENE	5.0E-01	4.1E-01	5.0E-03
GAMMA BHC	5.0E-01	1.0E-02	
HEPTACHLOR	5.0E-01	1.0E-02	
HEPTACHLOR EPOXIDE	5.0E-01	1.0E-02	
HEXACHLOROBENZENE	5.0E-01	4.1E-01	5.0E-03
HEXACHLOROBUTADIENE	5.0E-01	4.1E-01	5.0E-03
HEXACHLOROCYCLOPENTADIENE	5.0E-01	4.1E-01	5.0E-03
HEXACHLOROETHANE	5.0E-01	4.1E-01	5.0E-03
INDENO (1,2,3-CD) PYRENE	5.0E-01	4.1E-01	5.0E-03
ISOPHORONE	5.0E-01	4.1E-01	5.0E-03

Table E2 (continued)

Organic compound	Sediment (mg/kg, dry)	Fish (mg/kg, wet)	Water (mg/L)
METHYL BROMIDE	8.0E-03	5.0E-02	1.0E-02
METHYL CHLORIDE	8.0E-03	5.0E-02	1.0E-02
METHYLENE CHLORIDE		2.5E-01	5.0E-03
N-BUTYL BENZYL PHTHALATE	5.0E-01	4.1E-01	5.0E-03
N-NITROSODI-N-PROPYLAMINE	5.0E-01	4.1E-01	5.0E-03
N-NITROSODIMETHYLAMINE	5.0E-01	4.1E-01	5.0E-03
N-NITROSODIPHENYLAMINE	5.0E-01	4.1E-01	5.0E-03
NAPHTHALENE	5.0E-01	4.1E-01	5.0E-03
NITROBENZENE	5.0E-01	4.1E-01	5.0E-03
P,P'DDD	5.0E-01	1.0E-02	
P,P'DDE	5.0E-01	1.0E-02	
P,P'DDT	5.0E-01	1.0E-02	
PARACHLOROMETA CRESOL	5.0E-01	4.1E-01	5.0E-03
PCB-1254	1.0E-01	1.0E-02	1.0E-03
PCB-1260	1.0E-01	1.0E-02	1.0E-03
PENTACHLOROPHENOL	5.0E-01	4.1E-01	2.5E-02
PHENANTHRENE	5.0E-03	4.1E-01	5.0E-03
PHENOL	5.0E-01	4.1E-01	5.0E-03
PYRENE	2.0E-03	4.1E-01	5.0E-03
TETRACHLOROETHYLENE		5.0E-02	5.0E-03
TOLUENE	8.0E-03	5.0E-02	5.0E-03
TOXAPHENE	5.0E+00	5.0E-01	
TRANS-1,2-DICHLOROETHENE	8.0E-03	5.0E-02	5.0E-03
TRICHLOROETHYLENE		5.0E-02	5.0E-03
TRICHLOROFLUOROMETHANE	8.0E-03	5.0E-02	1.0E-03
VINYL CHLORIDE	8.0E-03	5.0E-02	5.0E-03

Table E3. Lowest limits of detection reported in the data base
for radionuclides

Radionuclide	Sediment (Bq/kg, dry)	Fish (Bq/kg, wet)	Water (Bq/L)
Am-241			1.0E-03
Cm-244			3.0E-03
Co-60	1.5E+00		9.3E-02
Cs-137	1.5E+00		9.3E-02
Pu-238			1.0E-03
Pu-239			1.0E-03
U-235	7.4E+00		
U-236			4.4E-06
U-238	1.0E+02		

Table E4. Carcinogen screening indices for inorganics by pathway
using lowest limits of detection reported in data base
and nonconservative estimates of exposure

Inorganic compound	Exposure pathways		
	Sediment ingestion	Fish ingestion	Drinking water
BERYLLIUM		3.7E-06	7.7E-06
ARSENIC	1.3E-06	1.5E-06	6.3E-06
URANIUM	1.6E-13		2.0E-11
Pathway total	1.3E-06	5.2E-06	1.4E-05

Table E5. Carcinogen screening indices for organics by pathway
using lowest limits of detection reported in data base
and nonconservative estimates of exposure

Organic compound	Exposure pathways		
	Sediment ingestion	Fish ingestion	Drinking water
BENZIDINE	1.1E-04	2.1E-02	4.1E-03
N-NITROSODIMETHYLAMINE	3.6E-06	9.0E-04	9.1E-04
BIS (CHLOROMETHYL) ETHER	2.5E-07	4.7E-04	
ACENAPHTHYLENE	8.2E-07	2.0E-04	2.1E-04
BENZO(B)FLUORANTHENE	8.2E-07	2.0E-04	2.1E-04
BENZO(GH)PERYLENE	8.2E-07	2.0E-04	2.1E-04
BENZO(K)FLUORANTHENE	8.2E-07	2.0E-04	2.1E-04
BENZO-A-PYRENE	8.2E-07	2.0E-04	2.1E-04
FLUORENE	8.2E-07	2.0E-04	2.1E-04
INDENO (1,2,3-CD) PYRENE	8.2E-07	2.0E-04	2.1E-04
ACENAPHTHENE	6.6E-09	2.0E-04	2.1E-04
CHRYSENE	4.9E-09	2.0E-04	2.1E-04
ANTHRACENE	3.3E-09	2.0E-04	2.1E-04
FLUORANTHENE	3.3E-09	2.0E-04	2.1E-04
PYRENE	3.3E-09	2.0E-04	2.1E-04
1,2,5,6-DIBENZANTHRACENE	8.2E-07	2.0E-04	2.1E-04
BENZO(A)ANTHRACENE	1.3E-08	2.0E-04	2.1E-04
PHENANTHRENE	8.2E-09	2.0E-04	2.1E-04
N-NITROSODI-N-PROPYLAMINE	5.0E-07	1.2E-04	1.3E-04
HEXACHLOROBENZENE	1.2E-07	3.0E-05	3.0E-05
VINYL CHLORIDE	2.6E-09	4.9E-06	4.1E-05
BIS (2-CHLOROETHYL) ETHER	7.9E-08	1.9E-05	2.0E-05
3,3'-DICHLOROBENZIDINE	1.0E-07	1.9E-05	1.6E-05
PCB-1260	1.1E-07	3.3E-06	2.8E-05
TOXAPHENE	7.9E-07	2.4E-05	
2,4-DINITROTOLUENE	4.9E-08	1.2E-05	1.2E-05
2,6-DINITROTOLUENE	4.9E-08	1.2E-05	1.2E-05
1,2-DIPHENYLHYDRAZINE	5.7E-08	1.4E-05	
1,1-DICHLOROETHYLENE	6.9E-10	1.3E-06	1.1E-05
ALDRIN	1.2E-06	7.3E-06	
DIELDRIN	1.1E-06	6.9E-06	
HEPTACHLOR EPOXIDE	6.5E-07	3.9E-06	
1,1,2,2-TETRACHLOROETHANE	2.3E-10	4.3E-07	3.6E-06

Table E5 (continued)

Organic compound	Exposure pathways		
	Sediment ingestion	Fish ingestion	Drinking water
1,3-DICHLOROPROPENE	2.1E-10	3.9E-07	3.2E-06
ALPHA BHC	4.5E-07	2.7E-06	
HEXACHLOROBUTADIENE	5.6E-09	1.4E-06	1.4E-06
CARBON TETRACHLORIDE	1.5E-10	2.8E-07	2.3E-06
DICHLOROBROMOMETHANE	1.5E-10	2.8E-07	2.3E-06
HEPTACHLOR	3.2E-07	1.9E-06	
1,1-DICHLOROETHANE	1.0E-10	2.0E-07	1.6E-06
1,2-DICHLOROETHANE	1.0E-10	2.0E-07	1.6E-06
CHLORODIBROMOMETHANE	9.6E-11	1.8E-07	1.5E-06
1,2-DICHLOROPROPANE	7.8E-11	1.5E-07	1.2E-06
ACRYLONITRILE	6.2E-09	1.2E-06	
CHLORDANE	4.6E-07	5.6E-07	
TETRACHLOROETHYLENE		1.1E-07	9.1E-07
BETA BHC	1.3E-07	7.7E-07	
1,4-DICHLOROBENZENE	1.7E-09	4.2E-07	4.3E-07
2,4,6-TRICHLOROPHENOL	1.4E-09	3.5E-07	3.6E-07
BENZENE	3.3E-11	6.2E-08	5.2E-07
HEXACHLOROETHANE	1.0E-09	2.5E-07	2.5E-07
BIS (2-ETHYLHEXYL) PHthalate	6.0E-12	2.5E-07	2.5E-07
METHYL CHLORIDE	1.5E-11	2.8E-08	4.6E-07
TRICHLOROETHYLENE		2.4E-08	2.0E-07
METHYLENE CHLORIDE		8.0E-08	1.3E-07
N-NITROSODIPHENYLAMINE	3.5E-10	8.6E-08	8.8E-08
P,P'DDE	2.4E-08	1.5E-07	
P,P'DDT	2.4E-08	1.5E-07	
BROMOFORM	9.0E-12	1.7E-08	1.4E-07
ISOPHORONE	2.9E-10	7.2E-08	7.3E-08
1,1,2-TRICHLOROETHANE	6.5E-11	1.2E-07	
CHLOROFORM	7.0E-12	1.3E-08	1.1E-07
P,P'DDD	1.7E-08	1.0E-07	
Pathway total	1.2E-04	2.5E-02	8.4E-03

Table E6. Carcinogen screening indices for radionuclides by pathway
using lowest limits of detection reported in data base
and nonconservative estimates of exposure

Radionuclide	Exposure pathways			
	Sediment ingestion	Fish ingestion	Drinking water	Sediment external
U-238	2.6E-08			2.8E-06
Co-60	3.9E-11		6.1E-08	8.4E-07
U-235	1.9E-09			3.5E-07
Cs-137	7.3E-11		1.1E-07	2.2E-07
Cm-244			8.6E-08	
Am-241			5.4E-08	
Pu-239			1.1E-08	
Pu-238			9.8E-09	
U-236			2.9E-11	
Pathway total	2.8E-08		3.4E-07	4.2E-06

Table E7. Noncarcinogen screening indices for inorganics by pathway
using lowest limits of detection reported in data base
and nonconservative estimates of exposure

Inorganic compound	Exposure pathways		
	Sediment ingestion	Fish ingestion	Drinking water
THORIUM	4.1E-02		1.0E+01
THALLIUM	1.0E-02	6.1E-01	5.1E-01
ANTIMONY		1.1E-01	4.5E-01
MERCURY, TOTAL	4.8E-05	1.4E-02	6.0E-04
CHROMIUM		1.7E-04	7.1E-03
BARIUM			7.1E-03
ARSENIC	7.1E-04	8.6E-04	3.6E-03
SILVER	2.9E-05	2.9E-03	1.2E-03
VANADIUM			3.1E-03
NICKEL		2.1E-03	1.8E-04
SELENIUM	2.4E-04	2.9E-04	1.2E-03
URANIUM	9.5E-06		1.2E-03
BERYLLIUM		1.7E-04	3.6E-04
CYANIDE	5.0E-06		3.6E-04
BORON			1.6E-04
TIN			6.0E-05
CADMIUM	4.8E-07	9.5E-07	4.0E-05
ZINC	7.1E-08		1.8E-05
Pathway total	5.2E-02	7.4E-01	1.1E+01

Table E8. Noncarcinogen screening indices for organics by pathway using lowest limits of detection reported in data base and nonconservative estimates of exposure

Organic compound	Exposure pathways		
	Sediment ingestion	Fish ingestion	Drinking water
4,6-DINITRO-ORTHO-CRESOL	3.6E-03		8.9E-01
2,4-DINITROPHENOL	3.6E-04	8.8E-02	8.9E-03
NITROBENZENE	1.4E-04	3.5E-02	3.6E-02
1,3-DICHLOROPROPENE	3.8E-06	7.1E-03	6.0E-02
HEXACHLOROBENZENE	8.9E-05	2.2E-02	2.2E-02
HEPTACHLOR EPOXIDE	5.5E-03	3.3E-02	
BENZIDINE	1.5E-04	3.0E-02	6.0E-03
HEXACHLOROETHANE	7.1E-05	1.8E-02	1.8E-02
CARBON TETRACHLORIDE	1.6E-06	3.1E-03	2.6E-02
METHYL BROMIDE	8.2E-07	1.5E-03	2.6E-02
HEXACHLOROBUTADIENE	3.6E-05	8.8E-03	8.9E-03
ALDRIN	2.4E-03	1.4E-02	
CHLORDANE	6.0E-03	7.1E-03	
2,4-DICHLOROPHENOL	2.4E-05	5.9E-03	6.0E-03
DIELDRIN	1.4E-03	8.6E-03	
ENDOSULFAN, ALPHA	1.4E-03	8.6E-03	
ENDOSULFAN, BETA	1.4E-03	8.6E-03	
2-CHLOROPHENOL	1.4E-05	3.5E-03	3.6E-03
HEXACHLOROCYCLOPENTADIENE	1.0E-05	2.5E-03	2.6E-03
PENTACHLOROPHENOL	2.4E-06	5.9E-04	3.0E-03
1,1-DICHLOROETHYLENE	1.3E-07	2.4E-04	2.0E-03
CHLOROFORM	1.1E-07	2.1E-04	1.8E-03
TETRACHLOROETHYLENE		2.1E-04	1.8E-03
1,2,4-TRICHLOROBENZENE	3.6E-06	8.8E-04	8.9E-04
BIS (2-ETHYLHEXYL) PHTHALATE	2.1E-08	8.8E-04	8.9E-04
ENDRIN	2.4E-04	1.4E-03	
BROMOFORM	5.7E-08	1.1E-04	8.9E-04
CHLOROBENZENE	5.7E-08	1.1E-04	8.9E-04
CHLORODIBROMOMETHANE	5.7E-08	1.1E-04	8.9E-04
DICHLOROBROMOMETHANE	5.7E-08	1.1E-04	8.9E-04
TRANS-1,2-DICHLOROETHENE	5.7E-08	1.1E-04	8.9E-04
HEPTACHLOR	1.4E-04	8.6E-04	

Table E8 (continued)

Organic compound	Exposure pathways		
	Sediment ingestion	Fish ingestion	Drinking water
P,P'DDT	1.4E-04	8.6E-04	
BIS (2-CHLOROISOPROPYL) ETHER	1.8E-06	4.4E-04	4.5E-04
1,1,2-TRICHLOROETHANE	2.9E-07	5.4E-04	
METHYLENE CHLORIDE		1.8E-04	3.0E-04
1,2-DICHLOROBENZENE	7.9E-07	2.0E-04	2.0E-04
DI-N-BUTYL PHTHALATE	4.3E-09	1.8E-04	1.8E-04
1,1,1-TRICHLOROETHANE	1.3E-08	2.4E-05	2.0E-04
1,1-DICHLOROETHANE	1.1E-08	2.1E-05	1.8E-04
ETHYLBENZENE	1.1E-08	2.1E-05	1.8E-04
ISOPHORONE	3.6E-07	8.8E-05	8.9E-05
N-BUTYL BENZYL PHTHALATE	3.6E-07	8.8E-05	8.9E-05
ACROLEIN	7.1E-07	1.3E-04	
DICHLORODIFLUOROMETHANE	5.7E-09	1.1E-05	8.9E-05
NAPHTHALENE	1.8E-07	4.4E-05	4.5E-05
TOLUENE	3.8E-09	7.1E-06	6.0E-05
PHENOL	1.2E-07	2.9E-05	3.0E-05
DIETHYL PHTHALATE	1.1E-07	2.2E-05	2.2E-05
TRICHLOROFUOROMETHANE	3.8E-09	7.1E-06	1.2E-05
Pathway total	2.3E-02	3.1E-01	1.1E+00

Appendix F

**COMPARISON OF SCREENING RESULTS USING HEALTH RISK
AND ECOLOGICAL END POINTS**



APPENDIX F

One of the initial tasks of the CRRFI off-site investigation was to conduct a screening analysis using health risk and ecological screening methodologies to identify contaminants that represent potential risk to human health or the environment. The present report contains the results of the screening analysis using health risk screening end points, and a report by Suter (1990) gives the results for screening the same data base using ecological screening risk end points. Ecological end points in the environmental assessment were a 10% or greater reduction in the abundance or production of the local populations of (1) any fish species, (2) any bird species, or (3) wild mammals species other than small rodents. Other end points were a 10% reduction in the production of any local plant population and any toxic effect on individuals of an endangered species sufficient to impair survival or reproduction. Except for the endangered species, the end points are effects at the population level of biological organization. A comparison of contaminants assigned a potentially high priority by health risk end points and contaminants assigned a high priority by ecological risk end points is given in Table F1.

Table F1. Comparison of contaminants assigned a potentially high priority through conservative screening by health risk criteria (this study) with those screened by environmental risk criteria

Contaminant	Reach	Screening End points	
		Health Risk	Environ. Toxicity
Inorganic Chemicals			
Aluminum	2	^a	X
	3	^a	X
	4	^a	X
Antimony	1	X	--
	2	X	--
	3	X	--
Arsenic	1	X	--
	2	X	X
	3	X	X
	4	X	X
	5	X	--
	10	X	--
	13	X	--
	18	X	--
Barium	4	X	--
Beryllium	1	X	--
	2	X	--
	3	X	--
	4	X	--
	5	X	--
Boron	3	X	X
	4	X	--
Cadmium	2	X	X
	3	X	X
	4	X	X
Calcium	2	^b	X
	3	^b	X
	4	^b	X

Table F1 (continued)

Contaminant	Reach	Screening End points	
		Health Risk	Environ. Toxicity
Inorganic Chemicals (continued)			
Chromium	1	X	X
	2	X	X
	3	X	X
	4	X	X
	5	X	--
	10	X	--
	18	X	--
Copper	1	a	X
	2	a	X
	3	a	X
	4	a	X
	5	a	--
	13	a	X
Cyanide	13	d	X
Lithium	1	c	X
	3	c	X
Lead	1	a	--
	2	a	X
	3	a	X
	4	a	X
	5	a	--
	10	a	--
	13	a	--
Manganese	5	b	X
Mercury	1	X	X
	2	e	X
	3	X	X
	4	X	X
	5	X	X
	10	e	X
	13	e	X
	18	X	X

Table F1 (continued)

<u>Contaminant</u>	<u>Reach</u>	<u>Screening End points</u>	
		<u>Health Risk</u>	<u>Environ. Toxicity</u>
Inorganic Chemicals (continued)			
Nickel	3	X	X
	4	X	--
	13	X	--
Selenium	1	X	--
	2	X	--
	3	X	X
	4	X	X
	5	X	--
Silver	2	X	X
	3	X	X
	4	X	X
Thallium	1	X	X
	2	X	--
	3	X	--
Uranium	2	X	X
	3	X	X
	4	e	X
Vanadium	4	X	X
Zinc	1	X	--
	2	X	X
	3	X	X
	4	X	X
	5	X	--
	13	X	--

Table F1 (continued)

Contaminant	Reach	Screening End points	
		Health Risk	Environ. Toxicity
Organic Chemicals			
Chlordane	1	X	--
	2	X	--
	4	X	--
PCB-1254	1	X	X
	2	X	X
	3	X	X
	4	X	X
	5	X	X
	18	X	X
PCB-1260	1	X	X
	2	X	X
	3	X	X
	4	X	X
	5	X	X
Vinyl Chloride	3	X	--
Anthracene	3	X	--
	4	X	--
Benzo(A)anthracene	3	X	--
	4	X	--
Chrysene	3	X	--
	4	X	--
DDT	1	e	X
	2	e	X
Fluoranthene	1	X	--
	3	X	--
Methylene chloride	3	X	--

Table F1 (continued)

<u>Contaminant</u>	<u>Reach</u>	<u>Screening End points</u>	
		<u>Health Risk</u>	<u>Environ. Toxicity</u>
Organic Chemicals (continued)			
Phenanthrene	3	X	--
	4	X	--
Pyrene	3	X	--
	4	X	--
<i>trans</i> -1,3-Dichloropropene	3	X	--
Carbon Tetrachloride	3	X	--
<i>trans</i> -1,2-Dichloroethane	3	X	--
Bis(2-ethylhexyl)phthalate	3	X	X
4,6-Dinitro-ortho-cresol	1	X	--
	3	X	--
Radionuclides			
Sr-90	2	X	--
	4	X	--
Cs-137	2	X	--
	4	X	--
	5	X	--
H-3	2	X	--
Co-60	2	X	--
	3	X	--
	4	X	--
	5	X	--
Eu-152	2	X	--
Eu-154	2	X	--

Table F1 (continued)

Contaminant	Reach	Screening End points	
		Health Risk	Environ. Toxicity
Radionuclides (continued)			
Am-241	2	X	--
	4	X	--
Pu-239	2	X	--
Pa-234	3	X	--
Cm-244	2	X	--
U-238	2	X	--
	3	X	--
	4	X	--

^aContaminants for which health screening indices were not estimated because EPA reference dose factors and cancer slope factors were not available.

^bEssential element not considered for health risk screening.

^cContaminant not listed in data base used for health risk screening.

^dDesignated as a definitely low priority contaminant for health risk screening.

^eDesignated as a contaminant of concern but not given a high priority.

Source: Suter 1990.

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